Research Paper Series

Analytical Studies Branch

Plant Turnover and Productivity Growth in Canadian Manufacturing

by John R. Baldwin and Wulong Gu

No. 193

Statistics Canada Statistique Canada

Canada

ANALYTICAL STUDIES BRANCH
RESEARCH PAPER SERIES

The Analytical Studies Branch Research Paper Series provides for the circulation, on a pre-publication basis, of research conducted by Branch staff, visiting Fellows and academic associates. The Research Paper Series is intended to stimulate discussion on a variety of topics including labour, business firm dynamics, pensions, agriculture, mortality, language, immigration, statistical computing and simulation. Readers of the series are encouraged to contact the authors with comments, criticisms and suggestions. A list of titles appears inside the back cover of this paper.

Papers in the series are distributed to Statistics Canada Regional Offices, provincial statistical focal points, research institutes, and specialty libraries. These papers can be downloaded from the Internet at *www.statcan.ca*.

To obtain a collection of abstracts of the papers in the series and/or copies of individual papers (in French or English), please contact:

Publications Review Committee
Analytical Studies Branch, Statistics Canada
18th Floor, R.H. Coats Building
Ottawa, Ontario, K1A 0T6
(613) 951-6325

Plant Turnover and Productivity Growth in Canadian Manufacturing

by

John R. Baldwin *

and

Wulong Gu **

11F0019 No. 193
ISSN: 1205-9153
ISBN: 0-662-32409-9

Micro-Economic Analysis Division
24-B R.H. Coats Building
Ottawa, K1A 0T6
Statistics Canada
Facsimile Number: (613) 951-5403

* (613) 951-8588
Email: baldjoh@statcan.ca

** (613) 951-0754
Email: wulong.gu@statcan.ca

April 2, 2003

The authors' names are listed alphabetically.

The paper has been published in the OECD STI Working Papers 2002/2.

This paper represents the views of the authors and does not necessarily reflect the opinions of Statistics Canada.

Aussi disponible en français

103-03727/

Table of Contents

ABSTRACT V

EXECUTIVE SUMMARY VII

ACKNOWLEDGEMENTS XI

1. INTRODUCTION 1

2. ALTERNATIVE METHODOLOGIES FOR MEASURING THE CONTRIBUTION OF PLANT TURNOVER TO PRODUCTIVITY GROWTH 3

3. INTERPRETATION OF PRODUCTIVITY DECOMPOSITIONS 8

4. DATA 11

5. PLANT TURNOVER 12

5.1 Plant Turnover and Productivity Differentials among Entering, Exiting and Continuing Plants 12
5.2 Growth of Entering Plants 13

6. PLANT TURNOVER AND PRODUCTIVITY GROWTH 17

6.1 Aggregate 17
6.2 Plant Turnover among Foreign-Controlled vs. Domestic-Controlled Plants 20
6.3 Plant Turnover Among Single-Plant vs. Multi-Plant Firms 25

7. PLANT TURNOVER AND PRODUCTIVITY GROWTH AT INDUSTRY-LEVEL 28

7.1 Patterns of Entry and Exit at the 2-digit level 29
7.2 Plant Turnover and Trade Liberalization 31
7.3 Patterns of Entry and Exit in Innovative Industries 33

8. CONCLUSION 36

APPENDIX 37

REFERENCES 45

Abstract

Entry is important because new firms and new plants provide an important source of competition to incumbents. They are a source of new products and technologies. In this paper, we outline the size of the turnover in plants that have entered and exited the Canadian manufacturing sector over each of the last three decades—1973-1979, 1979-1988 and 1988-1997. We also examine the contribution of plant turnover to labour productivity growth in the manufacturing sector over the three periods. Plant turnover makes a significant contribution to productivity growth as more productive entrants replace exiting plants that are less productive. We also find that a disproportionately large fraction of the contribution of plant turnover to productivity growth is due to multi-plant or foreign-controlled firms closing down and opening up new plants. The plants opened up by multi-plant or foreign-controlled firms are typically much more productive than those opened by single-plant or domestic-controlled firms.

Keywords: productivity, entry and exit, plant turnover, multi-plant versus single plant firms, multinational versus domestic firms

Executive Summary

Productivity measures are usually produced for the entire economy or for an entire industry, not for individual businesses. This macro growth is the result of the sum of the growth in the underlying micro units that make up the population of firms.

Overall productivity growth may be the result of entry and exit or it may come from incumbents. Within the population, it may be produced primarily by domestic as opposed to foreign producers. Understanding which of the underlying producers are responsible for overall productivity growth is important to public policy. If it comes mainly from entry and exit, maintaining an open flexible economy that supports these adjustments is important. If it comes mainly from domestic firms, then it may be that the foreign sector is no longer the vehicle for the transfer of advanced technology to Canada that it once was.

This paper is both methodological and empirical. The first part of the paper asks how we can measure the contribution to overall productivity growth of the entry and exit components of firm and plant turnover. We examine several formulae that have been used in the literature to decompose the growth in productivity over time into separate entry and exit components. We argue that the decompositions are all too often treated as mechanical exercises. Each of the decompositions is mathematically correct; but the economic meaning underlying each depends on implicit assumptions about the dynamic process that is taking place within the firm and plant population. In particular, each formula is directly associated with a counterfactual assumption about the replacement process at work in the population of firms and plants—the process that has some businesses taking away market share from others.

The most frequently used formula assumes that entrants replace existing plants. We argue that the empirical evidence suggests that, at least for Canada, entrants essentially replace exits. Small firms and plants are not likely to replace larger existing firms and plants in most situations. New firms are smaller than the average incumbent. They pay lower wages. They are less productive (Baldwin and Rafiquzzaman, 1995). Competition takes place within subgroups of an industry (Neuman, 1978). New small firms are more likely to compete against other small firms. In doing so, entrants are most likely to displace exits.

After outlining the methodological issues that must be resolved before measurement can take place, the second section examines several empirical issues using the Canadian Census of Manufactures and a special longitudinal database on plants that has been derived therefrom. It examines changes that have occurred in each of the 1970s, the 1980s, and the 1990s. In doing so, it poses the following questions:

1) How important is the entry and exit process over the last three decades and has it changed?

Entry and exit are large. Some 40% of all manufacturing plants in existence in 1997 are new plants that entered over the 1988-1997 period. Some 47% of the manufacturing plants operating in 1988 were no longer in operation in 1997.

When measured in terms of employment, entry and exit rates are lower but still significant. The two comparable employment entry and exit rates for the 1988-1997 period are 20% and 27%, respectively.

The employment share of entrants and exits has been higher in the 1980s and 1990s compared to the 1970s. During the 1990s, exits have shot up relative to entrants, probably because of restructuring that is associated with North American trade liberalization.

2) What is the growth trajectory of entrants?

Entering plants undergo both a selection and a learning process as competition culls out less productive plants and the survivors improve productivity. The paper examines the growth process of entrants who came into existence in the 1980s and then survived over the 1990s. We find that the output and employment of these entrants grows more quickly than incumbents who also survive but the labour productivity of surviving entrants grows less quickly than surviving incumbents. While entrants therefore learn enough to improve their productivity, they are not learning as quickly as incumbent survivors.

On the other hand, those members of the entrant cohort who fail are much less productive than those who survive. As a result, the average productivity of a cohort of entrants tends to catch up with the average productivity of incumbents—but this is caused by the culling of the less efficient plants in an entry cohort.

In summary, new plants that manage to survive are considerably more productive than those who fail. They also become more productive than incumbents who fail. They are not more productive than the average incumbent and they are, therefore, unlikely to have gained market share from this group on average. Productivity decompositions that fail to recognize this fact will produce misleading estimates of the contribution of entry to the productivity process. In particular, they will tend to bias downward the contribution that entry makes.

3) How important is the contribution that is made by entry and exit to labour productivity growth?

Entering plants are considerably more productive than the exiting plants that they displace. Using continuing incumbents as the metric to which each is compared, we find that, during the period 1988-1997, entrants are 7% less productive than incumbents in 1997, while exits are almost 30% less productive than incumbents in 1988—a difference of some 22 percentage points.

As a result of this differential, the paper argues that the correct calculations show that plant turnover from entry and exit contributes 15% to 25% of labour productivity growth during the 1973-1979, 1979-1988, and 1988-1997 periods. It is important to note that it is not possible to separate the effect of entry from exit; since one causes the other, it is the net effect of the two taken together that is sensibly measured.

The contribution that entry and exit make to productivity growth is generally larger than their share of employment. But, over the three periods studied, their contribution to labour productivity growth has been falling. Plant turnover contributes a quarter of productivity growth in the 1973-1979 period, 20% in the 1979-1988 period, and 15% to 20% in the 1988-1997 period.

4) Are the most productive plants growing most rapidly?

To better explain the nature of the growth process that is taking place in the continuing population, we calculate correlations of labour productivity growth, output growth, employment growth, and initial labour productivity and employment levels across continuing plants. Two patterns consistently emerge.

First, there is virtually no correlation between output growth and initial labour productivity growth. That is, if we divide the population of plants into two groups based on initial labour productivity at the beginning of the period, we cannot predict future growth in market share.

Second, some plants do, however, gain market share. These plants also increase their share of employment. There is a positive correlation between output growth and labour productivity growth. There is a substantial shifting of relative position based on output that is associated with changes in relative productivity.

5) Are all entrants equally important?

All entrants do not contribute equally to productivity growth. A disproportionately large share of the contribution to labour productivity growth is due to foreign-controlled firms opening up or closing down plants. This reinforces other research (Baldwin and Dhaliwal, 2000) that has found foreign-controlled plants to be more productive than domestic plants and confirms that this difference has been reinforced by changes at the margin of the population that come from entry and exit.

The proportion of labour productivity growth that is accounted for by entry has been relatively constant over the last three decades; but the share of this, that has originated in domestic plants, has fallen over the period. Over the 1988-1997 period, foreign-controlled entrants account for 20% of employment of all entering plants and foreign-controlled exiters account for 28% of employment of all exiting plants. But plant turnover of foreign controlled firms provides 60% of the contribution from total plant turnover.

In summary, foreign-controlled plants have become increasingly important as a source of entry. They have become increasingly large relative to domestic entrants. They have become increasingly productive relative to both domestic entrants and relative to incumbents. The latter increase was particularly large in the period post FTA and NAFTA.

6) Are small single plant entrants the engines of growth?

The paper also examines the effect of the entry of small independent entrants as opposed to the creation of new plants that are part of large multi-plant enterprises. The closed plant and new plant associated with multi-plant firms are much larger than their counterparts in single-plant firms. Almost all of the contribution of plant turnover to productivity growth is due to more productive new plants of multi-plant firms displacing exiting plants of multi-plant firms.

It is also noteworthy that the continuing plant contribution of multi-plant firms greatly exceeds that of single-plant firms. A remarkable feature then of productivity growth in Canadian manufacturing is the predominant role of multi-plant firms. Multi-plant firms account for almost all of the productivity growth in Canadian manufacturing in the three periods we examined. Multi-plant firms account for 85% of growth in labour productivity in the 1973-1979 period and more than 90% of growth in the 1979-1988 and 1988-1997 periods. In 1997, multi-plant firms produced 75% of output and employed 60% of workers in Canadian manufacturing. The plants that are part of multi-plant firms accounted for 22% of all plants. The contribution of multi-plant firms to productivity growth is much greater than their share of employment. All of this suggests that small independent single-plant firms have had very little impact on aggregate productivity growth.

7) Are there differences across industries in the importance of entrants?

While there are substantial differences at the industry level in terms of the importance of entry, the important issue addressed in this paper is the extent to which this changes over time. We find that there are substantial similarities across time in the importance of entry and exit. This indicates that the underlying forces that allow for turnover and renewal via entry and exit are relatively constant.

The factor that strongly influences the contribution that is made by the entry of new plants and the exit of old plants to productivity growth is the productivity of each group relative to continuers or relative to one another. This variable will be determined by the ability of new plants to adopt new technologies relative to existing plants. In turn, this will be a function of the extent to which new technologies are best introduced into a new environment, or the extent to which the new technologies are best combined with other technologies in existing plants.

Here there is much less stability across decades. This suggests that the underlying technological factors that facilitate productivity growth via new entry are not stable over time. The paper then proceeds to test whether changes in trade intensity might be related to entry and exit. We find that increases in trade intensity (especially in intra-industry trade) in the 1990s have been associated with more entry and more exit and less net entry (gross entry less gross exit) on balance.

Acknowledgements

We would like to thank Bob Gibson and Andrée Girard for research assistance. This paper was prepared for the productivity growth project of the OECD. Views expressed in this paper do not necessarily reflect those of Statistics Canada or the OECD.

1. Introduction

A large number of plants enter and exit Canadian manufacturing every year. About 40% of the manufacturing plants in 1997 are new plants that entered over the 1988-1997 period, while half of the plants in 1988 were no longer operating in 1997. The objective of this paper is to examine the contribution of plant turnover to labour productivity growth in Canadian manufacturing over the three periods: 1973-1979, 1979-1988 and 1988-1997. The last period has been accompanied by a dramatic increase in export and import intensity as a result of the Free Trade Agreement (FTA) between Canada and the United States. In examining the general behaviour of plant turnover over the past three periods, we are looking for changes that may have resulted from industrial restructuring associated with the increases in trade liberalization that have occurred in the most recent period.

The sheer size of the amount of plant renewal taking place via plant openings and plant closings is a testament to its importance. Competition is intense when the identity of the players change and when firms are both closing and opening plants. Despite this, it is important to have supportive evidence of an effect of plant turnover on the performance of an industry.

Productivity growth is an important measure of performance and new firms that establish new plants affect the productivity of an industry. New firms experiment with new ideas and processes. New firms provide an important source of competition. Unfortunately productivity growth generally tends to be studied only at the aggregate industry level and therefore the effects of entry per se on productivity growth have not been well delineated. While Geroski (1991) has tried to relate technical progress, efficiency and productivity growth at the industry level to entry rates, his approach is somewhat of a 'black-box', using as it does aggregate industry productivity measures and entry rates. It does not explore the process that is driving productivity at the micro-level and, therefore, misses important detail. The link between productivity growth and entry requires a more detailed examination of data at the plant and firm level.

Even when this is done, the evidence on the effect of turnover on productivity is mixed. Some authors who have studied this phenomenon report that the contribution of entrants is relatively small (Hazledine, 1985; Bailey, Hulten and Campbell, 1992; Griliches and Regev, 1995). More recently, cross-country studies by the OECD (2001) suggest that it is not so much entry as exit that matters. On the other hand, Baldwin (1995) and Haltiwanger (1997) argue that the entry of new firms makes a substantial contribution to productivity growth.

The purpose of this paper is twofold. First, we examine the history of the last three decades to see whether the contribution that entry has made to productivity growth in Canada has changed. Second, we consider the alternate measures that have been suggested to capture the contribution of entry to productivity growth. We not only revisit the ways in which the contribution of entry to productivity growth may be measured but we explain the implicit differences in the assumptions that underlie each. We then examine the extent to which the different approaches yield different answers to the importance of entry in Canada. Finally, we ask whether particular types of entry are more important than others.

A number of previous studies have examined the implication of plant turnover for productivity growth in Canadian manufacturing (Baldwin and Gorecki, 1991; Baldwin, 1995). Using a longitudinal file developed from the Annual Census of Manufactures, Baldwin (1995) finds that entrants are typically much more productive than exiting plants and concludes that about 30% of labour productivity growth in Canadian manufacturing can be attributed to entry and exit over the 1970-1979 period. In this paper, we extend the estimates presented in Baldwin (1995) to subsequent periods and examine the difference in plant turnover between foreign- and domestic-controlled plants, between multi-plant and single-plant firms, and across different industries.

A distinguishing feature of Canadian manufacturing is the large presence of foreign-controlled plants (Baldwin and Dhaliwal, 2000). In 1997, foreign-controlled plants accounted for 10% of the number of plants in total manufacturing, contributing 30% of employment and half of output. Consequently, in this paper, we examine the role of plant renewal among foreign-controlled plants. In particular, we ask whether their contribution to productivity growth is larger than the contribution that is made by the domestic sector and whether it has been changing over time. We are particularly interested in finding out whether it has gone up in the post FTA period.

We also examine the relative importance of plant turnover among multi-plant vs. single-plant firms. New plants can be associated with the entry of a new firm or they can be associated with an existing firm. One way of distinguishing between the two is to examine the effect of new plants of single firms (which by definition have to be new firms) and the new plants that belong to multi-plant firms (which by definition are existing firms). Baldwin (1995) argues that plants started up by multi-plant firms are at the frontier of new knowledge and techniques and finds that the start-ups by multi-plant firms are much more productive than average manufacturing plants. But the contribution of the multi-plant as opposed to the single-plant group (de novo entrants) has not previously been measured for Canada. This lacunae is rectified here.

The paper also examines the extent to which the plant renewal process is more important in some sectors than others—both in terms of its size and its contribution to productivity growth. The 1990s have been characterized by rapid technical progress, especially in those industries that produce semi-conductors, computers and telecommunication equipment. Plant turnover is perceived to be more rapid and new plants perceived to contribute more strongly to productivity growth in the ICT (information and communication technology) sector than in other industries (OECD 2001). To examine the issue, we divide all manufacturing industries into three broad sectors: the core (ICT–related plus Chemicals), secondary and other sectors, and examine the difference in plant turnover among the three sectors.[1]

In Section 2 of this paper, we present alternative methodologies that have been used to decompose aggregate productivity growth into components, one of which is taken to represent the effect of plant turnover (entering and exiting plants), and another, that of continuing plants. In Section 3, we discuss the interpretation that should be placed on the terms that are derived from these traditional decompositions. In Section 4, we describe the data that are used.

[1] The core sector includes machinery, electrical equipment and chemicals where the dominant source of innovation is product innovation. The secondary sector mainly undertakes process innovation while the "other" sector conducts both product and process innovation (Robson, Townsend and Pavitt, 1988; Baldwin and Hanel, 2002).

Section 5, the first empirical section, documents the extent of plant turnover for the manufacturing sector as a whole, and examines the differences in average labour productivity among entering, exiting and continuing plants.

Also, in Section 5, we examine the importance of selection versus learning in the post-entry growth of new plants. One of the most important determinants of the impact of plant turnover on productivity growth in the long run is the post-entry growth of entering plants. Entering plants typically undergo both a selection and learning process as market competition sorts out high productivity from low productivity plants and the survivors increase their productivity. Selection occurs as the least productive plants are culled from an entry cohort. Learning occurs as the remaining entrants who start out at a disadvantage relative to incumbents improve their productivity.

We then combine the turnover and productivity statistics and use them to measure the contribution of plant turnover to productivity growth in aggregate manufacturing over the three periods: 1973-1979, 1979-1988 and 1988-1997. In this section, we also examine the relative contribution of plant turnover among foreign-controlled versus domestic-controlled plants to aggregate productivity growth as well as the relative role of plant turnover among single-plant firms versus multi-plant firms.

Section 7 examines differences in plant turnover and productivity growth for 22 manufacturing industries at the 2-digit SIC level (Standard Industrial Classification, 1980). We briefly examine the changes that have occurred over the last three decades and their relationship to changes in export and import intensity. We then divide the 22 two-digit industries into three groups, using a taxonomy based on the intensity of innovation taking place therein. These groups are the core, secondary and tertiary 'other' sectors. Differences in plant turnover among the three sectors are then examined. A brief conclusion follows in Section 8.

2. *Alternative Methodologies for Measuring the Contribution of Plant Turnover to Productivity Growth*

Productivity at the aggregate level is just a weighted average of the productivity of individual businesses. For expository purposes, we will refer to the business unit as a firm—though it equally well could be thought of as a plant in the following section. That is:

1) $P_t = \sum s_{it} p_{it}$ where P_t is aggregate labour productivity in period t, s_{it} is the employment share of plant i in period t, and p_{it} is labour productivity of firm i in year t

Changes in productivity will occur as some firms improve productivity and as employment share changes. Changes in employment shares reflect firm turnover (entry and exit) as well as growth and decline that occur within the continuing-firm sector. The contribution of continuing firms emanates from productivity growth taking place within individual firms and employment shifts

between individual firms—from those that are less productive to those that are more productive.[2] In this section, we examine alternate ways to measure each—with our primary emphasis on the issue of the contribution of entrants and exits to productivity growth.

Previous empirical studies have used different methods to measure the contribution of firm turnover to productivity growth (see Foster, Haltiwanger, and Krizan, 1998 for a review). For robustness, we use three alternative methods in this paper. The first method is proposed by Foster, Haltiwanger, and Krizan (1998) (FHK for short). The second is the decomposition approach used by Griliches and Regev (1995) (GR for short). This has recently been adopted by the OECD in their inter-country comparison of the importance of entry for productivity growth. The final method is the one used by Baldwin and Gorecki (1991) and Baldwin (1995).

All of the decomposition methods start with the identity that relates changes in labour productivity of an industry to that of firms comprising the industry:

$$2)\quad \Delta P_{t,t-\tau} = \sum_{i \in I} s_{it} p_{it} - \sum_{i \in I} s_{it-\tau} p_{it-\tau},$$

where $\Delta P_{t,t-\tau}$ is the change in labour productivity of an industry between year t and year $(t-\tau)$, s_{it} is the employment share of firm i in period t, p_{it} is labour productivity of firm i in year t.

Between year $t-\tau$ and year t, some firms will be operating throughout the period. Those firms are called "continuing firms"—the set C. Some firms operating in the end year t will be the firms that have entered the industry between $t-\tau$ and t. Those firms are referred to as entering firms—the set E. Some firms operating in the base year $t-\tau$ are no longer operating in the end year t. They are the exiting firms—the set X.

Changes in productivity can be rewritten as the difference between the weighted average of continuers and entrants in the second period minus the weighted average of continuers and exits in the first period:

$$3)\quad \Delta P_{t,t-\tau} = \left(\sum_{i \in C} s_{it} p_{it} + \sum_{i \in E} s_{it} p_{it}\right) - \left(\sum_{i \in C} s_{it-\tau} p_{it-\tau} + \sum_{i \in X} s_{it-\tau} p_{it-\tau}\right)$$

Or, rearranging Equation 3, the growth in productivity is just the growth in productivity in the continuing segment plus the growth that is added by the entering minus exiting firms.

$$4)\quad \Delta P_{t,t-\tau} = \left(\sum_{i \in C} s_{it} p_{it} - \sum_{i \in C} s_{it-\tau} p_{it-\tau}\right) + \left(\sum_{i \in E} s_{it} p_{it} - \sum_{i \in X} s_{it-\tau} p_{it-\tau}\right)$$

The change that is due to continuers (the first bracket in Equation 4) can be rewritten by adding and subtracting a term and judiciously rearranging existing terms. First add and subtract

5) $\sum_{i \in C} s_{it} p_{it-\tau}$ from the first term of Equation 4 and group terms to yield

[2] Alternatively, we can decompose the contribution of continuing plants into a component from those plants gaining market shares and that from those plants losing market shares (Baldwin, 1995).

$$6)\ \sum_{i\in C} s_{it}(p_{it} - p_{it-\tau}) + \sum_{i\in C}(s_{it} - s_{it-\tau})p_{it-\tau}$$

Similarly add and subtract

7) $\sum_{i\in C} s_{it-\tau} p_{it}$ from the first term of Equation 4 and group terms to yield:

$$8)\ \sum_{i\in C} s_{it-\tau}(p_{it} - p_{it-\tau}) + \sum_{i\in C}(s_{it} - s_{it-\tau})p_{it}$$

The two first terms in 6 and 8 measure the change in productivity of continuers weighted by terminal and opening period employment share respectively. The last term in both expressions is just the changes in labour shares weighted by the opening or terminal values of labour productivity respectively.

The mean of 6 and 8, which is itself equal to the first term in 4, is:

$$9)\ \sum_{i\in C} \overline{s}_i(p_{it} - p_{it-\tau}) + \sum_{i\in C}(s_{it} - s_{it-\tau})\overline{p}_i$$

This differs from Equations 6 and 8 in that mean shares and mean productivity are used, rather than first or terminal period values. Using this decomposition of the continuing segment plus the difference in productivity generated by entrants and exits yields

$$10)\ \Delta P_{t,t-\tau} = \sum_{i\in C} \overline{s}_i(p_{it} - p_{it-\tau}) + \sum_{i\in C}(s_{it} - s_{it-\tau})\overline{p}_i + (\sum_{i\in E} s_{it} p_{it} - \sum_{i\in X} s_{it-\tau} p_{it-\tau})$$

This decomposition can be extended to rewrite the effect of entrants and exits. To do so, a new term is added that equals zero and thus does not change the overall value of Equation 2. Recognizing that changes in the share of continuers over the period must just equal the difference between the share of entrants and exits, that is

$$11)\ \sum_{i\in C}(s_{it} - s_{it-\tau}) = -(\sum_{i\in E} s_{it} - \sum_{i\in X} s_{it-\tau})$$

Multiplying both sides by an arbitrary value of $\overline{P}$, the mean for the industry, gives

$$12)\ \overline{P}\sum_{i\in C}(s_{it} - s_{it-\tau}) + \overline{P}(\sum_{i\in E} s_{it} - \sum_{i\in X} s_{it-\tau}) = 0$$

Then subtracting 12 from 10 yields

$$13)\ \begin{aligned}\Delta P_{t,t-\tau} = &\sum_{i\in C} \overline{s}_i(p_{it} - p_{it-\tau}) + \sum_{i\in C}(s_{it} - s_{it-\tau})(\overline{p}_i - \overline{P}) \\ &+ \sum_{i\in E} s_{it}(p_{it} - \overline{P}) - \sum_{i\in X} s_{it-\tau}(p_{it-\tau} - \overline{P})\end{aligned}$$

This is the formula used by Griliches and Regev (1995). The first term in this decomposition is categorized as the within-firm component and measures the contribution of productivity growth within continuing firms holding their shares fixed. The second term is referred to as the between-firm component and captures the effect of the compositional shift in employment shares among continuing firms. The between-firm component contributes positively to productivity as output or employment shifts toward firms that are more productive than the average. The last two terms are taken to represent the contribution of firm turnover (entering and exiting firms).

Foster, Haltiwanger and Krizan (1998) use a modification of the same approach. Rather than averaging shares and productivity across time, they start with Equation 8 but then add and subtract $\sum_{i\in C}(s_{it}-s_{it-\tau})(p_{it-\tau})$ which in the place of Equation 13 yields

$$14)\quad \begin{aligned}\Delta P_{t,t-\tau} &= \sum_{i\in C} s_{it-\tau}(p_{it}-p_{it-\tau})+\sum_{i\in C}(s_{it}-s_{it-\tau})(p_{it-\tau}-\overline{P}) \\ &+\sum_{i\in C}(s_{it}-s_{it-\tau})(p_{it}-p_{it-\tau})+\sum_{i\in E} s_{it}(p_{it}-\overline{P})-\sum_{i\in X} s_{it-\tau}(p_{it-\tau}-\overline{P})\end{aligned}$$

And finally, they replace the industry average productivity for all firms taken over the two periods ($\overline{P}$) with the industry productivity for both continuers and exits in the first period ($P_{t-\tau}$), which yields

$$15)\quad \begin{aligned}\Delta P_{t,t-\tau} &= \sum_{i\in C} s_{it-\tau}(p_{it}-p_{it-\tau})+\sum_{i\in C}(s_{it}-s_{it-\tau})(p_{it-\tau}-P_{t-\tau}) \\ &+\sum_{i\in C}(s_{it}-s_{it-\tau})(p_{it}-p_{it-\tau})+\sum_{i\in E} s_{it}(p_{it}-P_{t-\tau})-\sum_{i\in X} s_{it-\tau}(p_{it-\tau}-P_{t-\tau})\end{aligned}$$

The first term and second terms are once again referred to as the within-firm component and the between-firm component. The third term is the covariance term in shares and productivity across continuing firms. The last two terms are taken to represent the contribution of firm turnover (entering and exiting firms).

The between-firm and firm-turnover components involve a comparison with productivity of an average firm. Continuing firms with increasing shares are said to contribute positively to aggregate productivity if they are more productive than an average firm in the base year. Entering firms are said to contribute positively to aggregate productivity if their productivity in the end year exceeds that of an average firm in the base year. For exiting firms, the contribution is said to be positive if they are less productive than an average firm in the base year.

The GR and the FHK methods differ in terms of the degree of disaggregation. FHK essentially provide a richer set of terms—that allows us to examine more than one type of change. The GR decomposition can only tell whether there is a contribution made by firms that are on average more productive because they increase their employment share. The FHK decomposition not only tells us whether the more productive firms as of the first period gain employment share but whether those firms who increase their productivity also increase employment.

However, the additional detail comes at a cost. First, as discussed in Foster, Haltiwanger and Krizan (1998), the FHK method will be sensitive to measurement errors in outputs and inputs.[3] For example, measurement errors in employment yield negative covariance between labour productivity and employment shares across firms as an upward (downward) bias in employment estimates generates downward (upward) bias in labour productivity estimates. Consequently, a negative covariance term in the FHK method might reflect a spurious correlation between changes in productivity and employment shares.

As a related point, the FHK method may suffer from "regression toward mean" associated with transitory changes in employment and output. On average, firms with large initial employment and output are more likely to have experienced transitory increases in employment and output during a recent period. These firms are in turn more likely to experience declines as transitory changes reverse themselves. The use of initial employment shares and initial productivity levels in the FHK method inappropriately attributes transitory changes related to "regression toward mean" to with-firm, between-firm and cross components.[4] But the importance of this point is a function of the time period chosen. If the decomposition formula is being applied on a year-to-year basis, stochastic regression to the mean is more likely to be a 'problem' than it is when it is being measured over longer periods.

The FHK and GR methods compare the entering and exiting firms with an average firm in the industry in measuring the contribution of firm turnover to productivity growth. Baldwin (1995) argues that entering firms essentially replace exiting firms. To properly account for the contribution of firm turnover, he suggests that it is more appropriate to compare productivity between entering and exiting firms. This can be done within the spirit of either the FHK or GR methods. In the first case, we replace the average productivity of an industry with that of exiters in the FHK method (referred to here as Baldwin 1):

$$(16)\quad \Delta P_t = \sum_{i\in C} s_{it-\tau}\Delta p_{it} + \sum_{i\in C}(p_{it-\tau} - P_{Xt-\tau})\Delta s_{it} + \sum_{i\in C}\Delta s_{it}\Delta p_{it} + \sum_{i\in N} s_{it}(p_{it} - P_{Xt-\tau}) - \sum_{i\in X} s_{it-\tau}(p_{it-\tau} - P_{Xt-\tau}),$$

where $P_{Xt-\tau}$ is the weighted average labour productivity of exiting firms in the base year. As the last term in Equation 3 equals zero, the above equation can be simplified to:

$$(17)\quad \Delta P_t = \sum_{i\in C} s_{it-\tau}\Delta p_{it} + \sum_{i\in C}(p_{it-\tau} - P_{Xt-\tau})\Delta s_{it} + \sum_{i\in C}\Delta s_{it}\Delta p_{it} + \sum_{i\in N} s_{it}(p_{it} - P_{Xt-\tau}),$$

The first three terms represent the contributions of continuing firms including within-firm effect, between-firm effect, and a co-variance term. The last term will be considered here as a measure of the contribution of firm turnover to aggregate productivity.[5]

---

[3] Microeconomic data files, especially those from administrative sources, often have errors that are not corrected by the editing and imputation procedures that are used to produce accurate aggregate totals from these files.

[4] Davis, Haltiwanger and Schuh (1996) discussed the "regression to mean" bias in many studies on size-growth relationship.

[5] The term is identical to the first term of Equation 9-2 in Baldwin (1995).

The second version (referred to here as Baldwin 2) replaces the industry average productivity with the exiters' average productivity in the GR method:

$$(18)\quad \Delta P_t = \sum_{i\in C} \bar{s}_i \Delta p_{it} + \sum_{i\in C} (\bar{p}_i - P_{Xt-\tau})\Delta s_{it} + \sum_{i\in N} s_{it}(p_{it} - P_{Xt-\tau}).$$

The three terms in the decomposition measure the contributions due to within-firm growth, between-firm compositional shifts and firm turnover.

3. *Interpretation of Productivity Decompositions*

The mechanical decompositions described in the previous section have been used to estimate the effect of various events—restructuring in the continuing-firm sector, entry and exit. While some of the terms have a certain intuitive appeal, not all do. In particular, the way in which the effects of entry and exit are calculated is, as we argue below, problematic. The mechanical decompositions are not based on very credible assumptions about the dynamics of firms. In what follows, we attempt to rectify this.

How can we decide on the measure to use to estimate the effect of entry? To decide on the appropriate measure, we need to develop a counterfactual—to specify what would have happened in the absence of entry. To do so, let us start by rewriting the productivity difference between two periods:

$$19)\quad \Delta P_{t,t-\tau} = (\sum_{i\in C} s_{it} p_{it} - \sum_{i\in C} s_{it-\tau} p_{it-\tau}) + (\sum_{i\in E} s_{it} p_{it} - \sum_{i\in X} s_{it-\tau} p_{it-\tau})$$

There are two limiting assumptions that can be made in developing the counterfactual.

In the first case, let us assume that without entry, exit would have occurred anyway and we would only have been left with incumbents in the second period. Entry in this scenario then does not affect the rate of exit of existing firms or their productivity. It only affects the market share of existing firms, who end up smaller than otherwise because entrants capture part of the market share that they otherwise would have obtained. Then productivity growth that would have occurred in the absence of entry is:

$$20)\quad \Delta P_{t,t-\tau} = (\sum_{i\in C} \tilde{s}_{it} p_{it} - \sum_{i\in C} s_{it-\tau} p_{it-\tau}) - \sum_{i\in X} s_{it-\tau} p_{it-\tau},$$ where $\tilde{s}_i$ is the share that incumbents would have in the absence of entrants

Then subtracting Equation 20 from Equation 19 gives an expression for the effect of entry

$$21)\quad \Delta P_{t,t-\tau(entry)} = \sum_{i\in E} s_{it} p_{it} - \sum_{i\in C} (\tilde{s}_{it} - s_{it}) p_{it}$$

Adding and subtracting $\sum_{i\in E} s_{it} \bar{P}_{Ct}$ produces

22) $\Delta P_{t,t-\tau(entry)} = \sum_{i \in E} s_{it}(p_{it} - \overline{P_{ct}})$

where $\overline{P}_{ct} = \sum_{i \in C} \underline{((\tilde{s}_{it} - s_{it})/k)} p_{it}$ which is a weighted average of productivity of continuers in the second period and $k = \sum_{i \in E} s_{it}$.

This expression is just the share of entrants times the difference in productivity of the average entrant and the average firm. But the average that should be used for this exercise is the weighted average of incumbents where the weights are the increase in shares that would have occurred without entry. In the absence of this information, using existing shares assumes that the increases would have been proportional to existing shares for all continuers. As the expression in Equation 21 demonstrates, when the average entrant is less productive than the average incumbent, this term will generally be negative.

A similar exercise for exits yields a formula identical to that for entrants—except that the effect is calculated relative to the productivity of existing firms in the first period. Once more, the counterfactual would have to assume that in the absence of exits, continuing firms would simply have picked up the slack. Then the effect of exits is simply the difference between the productivity of existing firms and exits, which is usually positive, weighted by the share of the exiting firms.

There is a second way in which we can approach the counterfactual. We can postulate that in the absence of entry, the firms that would have exited would have remained in the industry, that their market share in total is just that which entrants together captured, and that their productivity would have remained at the old levels. This is equivalent to arguing that there is no exogenous productivity gain that should be expected of exits and entrants in effect drive out exits. In this case, productivity growth would have been

23) $\Delta P_{t,t-\tau} = (\sum_{i \in C} s_{it} p_{it} - \sum_{i \in C} s_{it-\tau} p_{it-\tau}) + (\sum_{i \in X} \tilde{s}_{it} p_{it-\tau} - \sum_{i \in X} s_{it-\tau} p_{it-\tau})$

where $\tilde{s}_{it}$ is the share that exits would have achieved at the end of the period without entrants. Then subtracting Equation 23—the productivity growth expected if this counterfactual were true—from the actual productivity growth in Equation 19 yields the following expression for the effect of entry:

24) $\Delta P_{t,t-\tau(entry)} = (\sum_{i \in E} s_{it} p_{it} - \sum_{i \in X} s_{it-\tau} p_{it-\tau}) - (\sum_{i \in X} \tilde{s}_{it-\tau} p_{it-\tau} - \sum_{i \in X} s_{it-\tau} p_{it-\tau})$ which reduces to

25) $\Delta P_{t,t-\tau(entry)} = (\sum_{i \in E} s_{it} p_{it} - \sum_{i \in X} \tilde{s}_{it-\tau} p_{it-\tau})$

If we add and subtract $\sum_{i \in E} s_{it} \overline{P}_{xt-\tau}$ where $\overline{P}_{xt-\tau} = \sum_{i \in X} \frac{1}{k} s_{it-\tau} p_{it-\tau}$ is the average productivity of exits and $k = \sum_{i \in E} s_{it}$. This yields

$$26)\ \Delta P_{t,t-\tau(entry)} = \left(\sum_{i \in E} s_{it}\left(p_{it} - \overline{P}_{it-\tau}\right)\right)$$

This is just the term that is used in the Baldwin decomposition.

In summary, the measures of the effect of entry outlined in the previous section contain implicit assumptions about the way in which entry affects industry productivity. There are two questions that need to be answered before the appropriate measure can be agreed upon. First, from whom do entrants take away market share? Hazledine's (1985) and Griliche's method (1995) implicitly assumed that entrants take away market share from the average incumbent who is more productive than the average entrant. Not surprisingly, using this implicit assumption, they concluded that entry had a deleterious effect on overall productivity.

As a general rule, this assumption is inappropriate. Small new firms are not likely to replace larger firms in most situations. New firms are smaller than the average incumbents. They pay lower wages. They are less productive (Baldwin and Rafiquzzaman, 1995). Competition takes place within subgroups of an industry (Neuman, 1978). Small firms are more likely to compete against small firms. In doing so, entrants are most likely to displace exits. The evidence supporting this view is that the rate of entry and exit is closely related across industries (Cable and Schwalbach, 1991). Baldwin and Gorecki (1991) more carefully examine this proposition and find that, while entrants occasionally take share away from some incumbents who are even less productive than entrants, this is rare. Even when entrants take away share from the continuing population, they do not do so on a random basis. Baldwin (1995) demonstrated that, in these cases, entrants tend to take away share from continuers who are less productive than entrants. Therefore, weighted averages of incumbent productivity that are based in existing market shares in Equations 13 and 15 are generally inappropriate.

In what follows, we compare the results that are obtained from the GR, the FHK and the two Baldwin techniques to illustrate the magnitude of the differences that are produced by each. We focus primarily on the GR approach, not because we prefer it, but because the OECD in its most recent study of cross-country differences in the effect of turnover on productivity (OECD, 2001) has chosen this as its reference point.

The GR approach not only has the disadvantage that its implicit assumption about the effect of entry ignores the empirical evidence on entry. It also implicitly adopts a classification of incumbents that cannot come to grips with the more interesting facets of intra-industry competition. Internal change occurs within industries as firms trade market share. Some firms gain market share at the expense of others. But those gaining market share do not necessarily gain employment share—especially in the large-firm market segment. Thus asking what the productivity gains are in the group that gains employment share will tell us little about what is happening in the group who are succeeding in the market place. Baldwin (1995) reported that in the 1970s, a substantial proportion of the total growth in productivity occurred as a result of this shifting of market share. Neither the FHK method nor the GR approaches capture this aspect of change. An accompanying paper will examine whether the importance of the component arising from market share shifts among incumbents that was observed in the 1970s has changed over the decades of the 1980s and 1990s.

4. *Data*

The data for our analysis comes from a longitudinal file developed from the Annual Surveys of Manufactures (ASM). The ASM covers the Canadian manufacturing sector. It collects information on shipments, value added, inventories and employment for about 35,000 manufacturing plants in 1997 (for details, see Statistics Canada, 1979). The plants in the ASM are grouped to 236 manufacturing industries at the 4-digit 1980 SIC (Standard Industrial Classification, 1980) level. We focus on the plant as a business unit, rather than the firm, because it allows finer distinctions to be made in calculating the contribution of various subsets of the population to productivity growth.

The longitudinal file developed from the ASM follows manufacturing plants over the 1973-1997 period. Each plant in the file has a unique code that allows us to identify entering, exiting and continuing plants. In addition, a plant is assigned a unique firm number and thus plants can be classified as belonging to a firm that continues over time, or to a multi-establishment or a foreign-controlled firm. As a result, the file can be used to estimate new plant entry rates and new firm entry rates of various types (see Baldwin, Beckstead, and Girard, 2002). In this paper, we use the plant-based part of the file to define entry at the plant level. Entry is defined first as the arrival of new plants with employment in an industry, then is divided into those plants that are foreign- as opposed to domestic-controlled. Finally, plant entry is divided into those that are associated with single-plant firms and those that are associated with a multi-plant firm. The former arise from the entry of new firms; the latter are generally associated with the entry of firms from other industries and with new plant openings of firms that have already one plant in the industry concerned.

In this paper, we measure labour productivity of a plant as real gross output per worker.[6] This is done primarily to allow comparability to the OECD cross-country study. Real gross output is measured as shipments plus net inventory changes, deflated by a gross output deflator at the 4-digit level for the industry in which the plant is classified.

We examine entry and productivity change over three periods: 1973-1979, 1979-1988, and 1988-1997. These periods are chosen to give us broad comparability in terms of growth across the business cycle. Each period spans a growth period and allows us to measure the effect of entry over a long enough time period to average out inconsistencies that arise in the file. In both the middle 1970s and the early 1990s, the frame that was used for the manufacturing file fell behind the population and annual estimates of entry are biased downwards unless corrections are made for this. But by 1979 and 1997, improvements had been made in the population used for the survey and returned it to the norms regularly used.

The three periods resemble one another in terms of the rates of growth of labour productivity (Baldwin et al., 2001). But they differ in one major respect. The first two are characterized by slow but continuous declines in tariffs as a result of the Kennedy and Tokyo round of tariff cuts. The 1990s, however, are categorized by the implementation of the Free Trade Agreement (FTA) with the United States and then the North American Free Trade Agreement (NAFTA).

[6] Gross output is calculated as manufacturing shipments plus net changes in inventories of goods in process and finished products. The number of workers includes both production and salaried workers.

5. *Plant Turnover*

In this section, we present evidence on plant turnover and productivity growth for all of the manufacturing sector over the three periods that are broadly representative of the 1970s, the 1980s and the 1990s. As such, we are able to observe whether changes have occurred over the last three decades in turnover rates and their influence on the growth in labour productivity.

5.1 *Plant Turnover and Productivity Differentials among Entering, Exiting and Continuing Plants*

Plant turnover has been important in Canadian manufacturing over the last three decades (Table 1). Some 39% of the manufacturing plants in 1997 are new plants that entered over the 1988-1997 period. Some 47% of the manufacturing plants operating in 1988 were no longer operating in 1997.

Table 1. Plant Turnover and Productivity Differentials in Total Manufacturing

	Share of the Number of Plants	Employment Share	Average Size	LP* in the Base Year	LP* in the End Year
1973-1979					
Entering Plants	38.53	12.09	17.30	--	0.93
Exiting Plants	29.14	12.07	25.05	0.64	--
Continuing Plants	--	--	75.05	1.00	1.11
1979-1988					
Entering Plants	57.41	22.76	18.61	--	0.80
Exiting Plants	47.10	20.70	24.22	0.73	--
Continuing Plants	--	--	82.63	1.00	1.15
1988-1997					
Entering Plants	38.77	20.83	27.41	--	0.93
Exiting Plants	46.48	27.74	28.02	0.71	--
Continuing Plants	--	--	63.39	1.00	1.27

Note: The share of exiting plants in the number of plants, employment and output reflects the share in the base year. The share of entering plants reflects the share in the end year. Average size is defined as employment per plant. Average size for continuing plants reflects the size in the base year. *LP denotes Labour Productivity.

Entrants and exiters are on average much smaller than continuing plants, as reflected in the relatively smaller employment shares of entrants and exiters compared with the shares of the number of plants. Nevertheless, these shares are still large. Over 20% of employment in 1997 was in plants that were new since 1988; 27% of employment in 1988 was in plants that closed by 1997.

After corrections are made for the fact that the three time periods are not exactly the same, turnover increases over the three periods. The sum of the entry and exit employment rates is about 4% when annualized during the 1970s. By the 1990s, it has climbed to over 5.4%—an increase of some 35%.[7]

[7] We use the employment rather than the firm numbers rates for comparison purposes since they are less subject to change because of administrative practice associated with the survey.

Entry rates are broadly similar to exit rates, as has been previously reported for other countries (Geroski and Shwalbach, 1991). But the 1990s differ from the earlier period in that exit rates, both in terms of number of plants closed and the proportion of total employment therein, increase relative to entry during this decade.[8] This is symptomatic of a restructuring process that has accompanied the move to free North American Trade. Moreover, the average employment size of a new plant and a closed plant, when calculated relative to that of continuing plants, has increased quite dramatically during the 1990s.

But what is most important for this study is the large productivity differential between entering and exiting plants. The average labour productivity of entering plants relative to incumbent plants at the end year of each period is higher than exiting plants in the initial year of the period.[9] For example, labour productivity of the 1988-1997 entrants in 1997 was only 7% below that of continuing plants measured in 1988; while labour productivity of the 1988-1997 plant closedowns was almost 30% below that of continuing plants measured as of 1988. The large productivity differential between entering and exiting plants, when combined with high turnover suggests that plant turnover is an important source of productivity growth in Canadian manufacturing.

It is noteworthy that this relative productivity difference has not shown any long-run trend upwards. The differences between entrants and exits was some 19 percentage points in the 1970s, declined to about 7 percentage points in the 1980s, and then returned to about 22 percentage points in the 1990s.

It is also important to note that even by the end of these longish periods, new plants were not more productive than the plants that continued throughout the period. It is difficult therefore to envisage an entry process in which the new plants supplant an "average' or representative continuing plant. The relative productivity of entrants and exits and the fact that their shares are similar, strongly suggest that competition occurs primarily between these two groups—at least over the time period being examined here.

5.2 Growth of Entering Plants

The main factor that determines the contribution of plant turnover to productivity growth is the average productivity and size of entering plants in the end year. The larger and more productive the entering plants are in the end year, the larger their contribution to productivity growth will be. In this section, we examine the growth of entering plants.

Previous studies show that entering plants are a heterogeneous group, some more productive and some less productive. Entering plants undergo both a selection and a learning process as competition culls out less productive plants and the survivors improve productivity (Baldwin and Rafiquzzaman, 1995; Aw, Chen and Roberts, 1997; Foster, Haltiwanger and Krizan, 1998). Baldwin and Rafiquzzaman show that most of the improvement in an average entry cohort in the

[8] This result can also be found in other databases that can be used to study the manufacturing sector. See Baldwin, Beckstead and Girard (2002).

[9] Average labour productivity in the table is weighted by employment at each plant and is expressed relative to the weighted average for continuing plants in the base year.

1970s and 1980s comes from the culling process. In this section, we ask whether this is also the case for the 1990s.

To examine the roles of selection and learning, we focus on the plants that entered manufacturing between 1979 and 1988 and compare their survival and growth over the 1988-1997 period to incumbents—plants that did not enter between 1979-1988 but were nevertheless operating in 1988. To do so, we regress the log of labour productivity, employment, and output on a binary variable for the years 1988 and 1997 and binary variables to account for the difference between continuing plants and entrants. We also distinguish between incumbent plants as of 1988 that survive to 1997 and those that exit.

The results in Table 2 compare the various categories using the results of the regression analysis. In 1988, surviving entrants were 9% less productive, and 70% smaller than incumbents who would survive. On the other hand, entrants who will fail over the period are 23% less productive than surviving incumbents and some 80% smaller. Figure 1 depicts the differences between the survivors and the exiters from the entrant population. These results indicate that the competitive process culls out the less productive and the smaller entrants.[10]

Table 2. Comparing the Survival and Growth of Plants that Entered Between 1979-1988 (with the 1988 performance of continuing incumbents as the base)

Independent Variables	Dependent Variables		
	Labour Productivity	Employment	Output
Surviving members of the plants entered between 1979-88, interacted with year binary variable for:			
1988	91	30	28
1997	108	44	48
Exiting members of the plants entered in between 1979-88 in 1988	77	21	16
Surviving members of the incumbent plants, interacted with year binary variable for:			
1988	100	100	100
1997	122	91	112
Exiting members of the incumbent plants in 1988	91	64	58

Note: All regressions included 4-digit (SIC, 1980) industry fixed effects. The coefficients were estimated using weighted least squares with employment as weights. All values are significantly different from the reference group in 1988.

Learning can have two effects on entrants. On the one hand, it may allow them simply to improve their absolute productivity relative to their initial position. On the other hand, it may allow them to catch up with incumbents. To investigate the extent to which entrants learn after entry, we compare differences in growth between the surviving members of entering plants and incumbent plants (Figure 2).[11]

[10] See Baldwin, Bian et al. (2000) for a more extensive statistical analysis of the characteristics of exiting new firms.
[11] 54 % of the plants entered between 1979-88 were no longer operating in 1997.

Figure 1. Productivity and Size of the Survivors and Exiters of the Plants Entered in 1979-1988

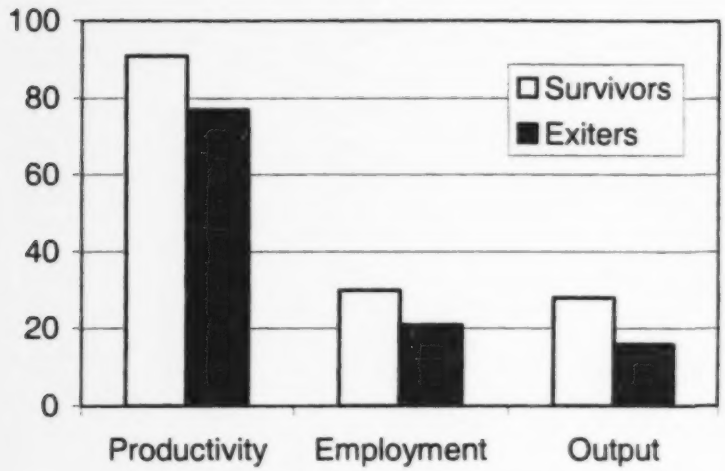
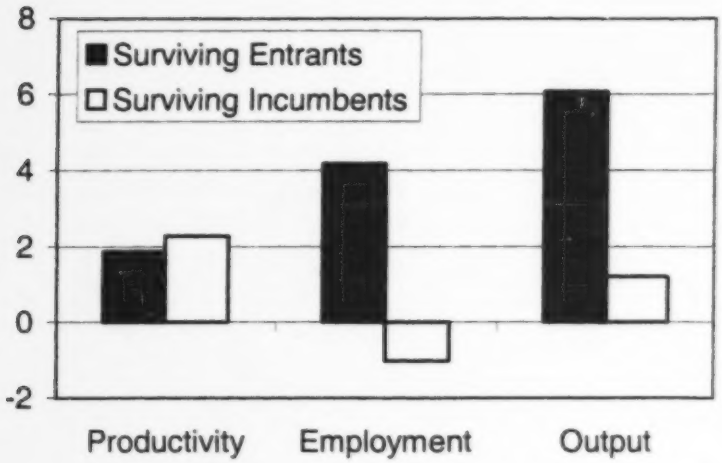


Figure 2. Annual Growth of Surviving Members of Entrants and Incumbents in the 1988-1997 (%)



During the period, surviving entrants experience growth in both their productivity and their size. Their relative employment size moves from some 30% of the 1988 size of incumbents to 44% in 1997; their relative labour productivity increases from 91% to 108%. Figure 2 translates this into relative growth rates and shows that the surviving members of entering plants do experience growth. During the 1988-1997 period, labour productivity of the surviving entrants grew 1.9% per year, while employment and output grew by 4.2% and 6.1% per year. Employment and output growth, but not the labour productivity of the surviving entrants, exceeded the growth of surviving incumbents.

This indicates that there has been some learning taking place in the surviving plants of the original entry cohort. Their employment and output size increases and their growth rate in these two dimensions is just as rapid as that of incumbents; but the productivity of the surviving incumbents grew much faster—moving them to about 122% of their original level by 1997, while entrants just moved from 91% to 108% of the 1988 incumbent level over the same period.

Thus, the surviving members of entering plants experience slower labour productivity growth than the surviving members of incumbent plants. In effect, any catch up of an entry cohort to incumbents is accounted for by the culling of the less efficient plants in an entry cohort. Baldwin and Rafiquzzaman (1995) interpret this as evidence that learning is less important than selection in the productivity growth of entering plants in Canadian manufacturing. As Baldwin and Dhaliwal (2000) note, this may be because entrants focus more on product innovations that meet the growth in market demand than they do on process innovations.

We also performed similar regressions for each of the twenty-two SIC 2-digit manufacturing industries.[12] Overall, the findings at the 2-digit industry level are consistent with those for the total manufacturing sector. The members of an entering cohort that have lower productivity and that are smaller are more likely to fail. The surviving members of entering plants experience substantial growth in labour productivity, employment and output.

To conclude, new plants that manage to survive are considerably more productive than those who fail. They also become more productive than incumbents who fail. They are not more productive than the average incumbent and they are, therefore, unlikely to have gained market share from this group on average. Productivity decompositions that fail to recognize this fact will produce misleading estimates of the contribution of entry to the productivity process.

[12] The results are available upon request from the authors.

6. *Plant Turnover and Productivity Growth*

6.1 Aggregate

The contribution of plant turnover to productivity growth in aggregate manufacturing is measured by applying the four separate decompositions outlined in Section 2 at the four-digit level (Table 3).[13] These four-digit results are then aggregated, using average industry employment shares as weights.[14]

Table 3. Productivity Decomposition in Total Manufacturing

	LP growth	Within-plant	Between-plant	Cross-plant	Net entry	Entry	Exit
FHK							
1973-1979	2.15	77.39	68.26	-70.67	25.03	10.94	14.09
1979-1988	1.41	101.79	16.01	-37.57	19.77	10.68	9.08
1988-1997	2.91	98.05	9.38	-22.02	14.59	8.87	5.71
GR							
1973-1979	2.15	42.03	32.73	--	25.24	5.61	19.63
1979-1988	1.41	83.04	-1.88	--	18.84	3.34	15.50
1988-1997	2.91	86.97	-5.24	--	18.27	1.00	17.28
Baldwin v1							
1973-1979	2.15	77.50	68.56	-70.77	24.71	--	--
1979-1988	1.41	101.75	15.98	-37.56	19.83	--	--
1988-1997	2.91	98.08	9.72	-22.03	14.23	--	--
Baldwin v1							
1973-1979	2.15	42.11	33.17	--	24.71	--	--
1979-1988	1.41	82.97	-2.80	--	19.83	--	--
1988-1997	2.91	87.07	-1.30	--	14.23	--	--

Note: Labour Productivity (LP) Growth is annual percentage point growth in labour productivity.

The results from all four decomposition methods show that productivity growth within continuing plants is the predominant source of labour productivity growth in Canadian manufacturing. Moreover most of this comes from the within-plant component. The contribution of the within-plant component ranges from 40% to 100% of aggregate productivity growth.

The component that measures the effect of compositional changes arising from shifts in employment shares among continuing plants plays a negligible to modest role in aggregate productivity growth after 1979. However, the compositional shift of employment toward more productive plants is an important source of productivity growth before 1979, accounting for 30% to 70% of labour productivity growth in the 1973-1979 period.

[13] Table 3 uses gross output per worker, a measure of labour productivity. Table 1 in the appendix presents decomposition results using value added per worker and shows similar results.

[14] The employment shares are averaged over the base and end years of each period.

Plant turnover is an important source of productivity growth as more productive entrants replace exiting plants that are less productive. Both the GR and FHK methods can be compared to the Baldwin decomposition by summing the effect of entry and exit separately. When this is done, the different approaches yield similar conclusions. The net measured impact of entry and exit does not appear to be very sensitive to the methods used. Plant turnover arising from entry and exit contributes a quarter of productivity growth in the 1973-1979 period, 20% in the 1979-1988 period, and 15% to 20% in the 1988-1997 period.

It is noteworthy that the contribution of entry and exit jointly has declined over time. Despite the increase in plant turnover, the Canadian economy has therefore seen the contribution to productivity growth by plant turnover fall over the last three decades.

The FHK and GR methods further decompose the contribution of plant turnover into that from entering plants and that from exiting plants—though, we have argued, both use implicit assumptions about the competitive process that are not applicable to Canadian circumstances. While the two methods yield similar estimates of the contribution of plant turnover, it should be noted that they provide very different estimates of the relative importance of entry versus exit. The FHK decomposition shows that entering and exiting plants make similar contributions to productivity growth. In contrast, the GR method suggests that most of the contribution from plant turnover comes from exiting plants. The difference derives from the fact that FHK compare entrants to average productivity in the beginning of the period and GR compares it to average productivity over the entire period. This decreases the effect of entry using the GR method, which essentially assumes that replacement is occurring not of an average plant at the beginning of the period but the average plant somewhere in the middle of the period.

Fourth, the GR and the FHK method yield quite different estimates of the contribution of within as opposed to between plant productivity growth. The FHK method suggests that the continuing plant population contributes large within-plant-growth—but this is generally offset by a negative contribution from employment reallocation across plants. In particular, the cross-variance component in the FHK decomposition that catches the relationship between changes in labour productivity and employment share is negative and large. The GR method produces much smaller estimates of within-plant productivity growth.

To better explain the nature of the growth process that is taking place in the continuing population, we calculate correlations[15] of labour productivity growth, output growth, employment growth, and initial labour productivity and employment levels across continuing plants for the 1988-1997 period—Table 4.[16] The correlations show a pattern that has been reported elsewhere (Baldwin, 1995, Baldwin, Diverty and Sabourin, 1995, Baldwin and Sabourin, 2001). First, there is virtually no correlation between output growth and initial labour productivity growth. That is, if we divide the population of plants into two groups based on initial labour productivity at the beginning of the period, we cannot predict future growth in market share or in labour productivity.

[15] Correlation matrices are calculated using employment in the base year as weights.
[16] The correlation matrices for the other two periods are similar.

Second, some plants do, however, grow larger than others and these plants also increase their share of employment—there is a positive correlation between output and labour growth. And the plants that are increasing market share are also growing their labour productivity more quickly—there is a positive correlation between output growth and labour productivity growth. This correlation can arise in one of two ways. First, labour productivity growth may improve efficiency, allow a plant to reduce its relative price and allow it to increase its market share. Second, increasing market share may increase profitability and lead to more investment thereby increasing labour productivity. In any case, there is a substantial shifting of relative position that is associated with changes in relative productivity. However, these shifts are not reflected in concomitant shifts in employment share. Labour productivity growth is negatively correlated with employment growth. Those plants that expand market share also increase employment, but there must be enough other plants also increasing employment—those losing market share—that the overall relationship between employment share and labour productivity is negative. It is this negative covariance term that shows up in the FHK decomposition of plant productivity growth.

Despite the differences in the levels of the GR and FHK methods, there is one common finding. In both cases, the within-plant component increases over time. This suggests that the net effect of reallocation of labour has become less important over time in Canada.

For the rest of the paper, we report the results using the GR method since this gives us comparability to the published OECD results. We note that the net effect of entry and exit that this technique produces is close to that produced by the Baldwin method.

Table 4. Correlation of Productivity, Output and Employment Among Continuing Plants, 1988-1997

	LP Growth	Output Growth	Labour Growth	Initial LP	Initial Labour
LP Growth	1				
Output Growth	0.49*	1			
Labour Growth	-0.22*	0.74*	1		
Initial LP	-0.04*	-0.02*	0.01	1	
Initial Labour	0.17*	-0.03*	-0.17*	0.21*	1

Note: Correlation matrices are calculated using employment in the base year as weights. One asterisk denotes statistical significance at the 1% level. LP denotes labour productivity or output per worker.

6.2 Plant Turnover among Foreign-Controlled vs. Domestic-Controlled Plants

Foreign-controlled plants contributed about 50% of manufacturing output in 1997. They are perceived to transmit new production techniques and business practices from abroad and are an important source of productivity growth (Globerman, 1999). Baldwin and Dhaliwal (2000) report that the average labour productivity of multinationals is higher than for domestic plants and that it has been growing over the last two decades. In this section, we focus on the contribution that plant turnover among foreign-controlled plants makes to productivity growth.

The shares of entrants, exiters and continuers accounted for by foreign versus domestic plants, along with their relative productivity are presented in Table 5. Foreign-controlled continuing plants are much more productive than domestic-controlled continuing plants and the gap is widening. Foreign-controlled continuing plants are 70% more productive than domestic-controlled ones in 1988, but they are 110% more productive in 1997—an increase of some 40 percentage points. In the 1980s, they increased their relative productivity by about 20 percentage points. There was virtually no change in the 1970s in their relative labour productivity advantage.

An important fraction of the employment and output affected by plant turnover is due to foreign-controlled firms opening up and closing down plants. Over the 1988-1997 period, foreign-controlled entering plants accounted for 6% of new plants, but 20% of employment and 40% of output of all entrants (Figure 3). Foreign-controlled exiting plants accounted for 8% of exiting plants, but 28% of employment of all exiters and 40% of output.

Trade liberalization has increased dramatically in the 1990s. And the importance of foreign entrants has increased dramatically as well—from 26% in the 1970s to 40% in the 1990s. On the other hand, their share of employment has remained virtually constant—22%, 15%, and 20% in the three decades.

Foreign entrants and exits are more productive than their domestic counterparts. Moreover, their productivity has increased relative to domestic entrants over this period. Figure 4 plots the relative productivity of foreign entrants compared to domestic entrants over the three periods. Starting at 1.6 times domestic entrants in the 1970s, the relative productivity had increased to 2.6 times that of domestic entrants by the 1990s. Foreign exits also were more productive than domestic exits, but here there is not a continuous upward trend.

Table 5. Plant Turnover and Productivity Differentials in Total Manufacturing, Foreign- vs. Domestic-controlled Plant

		Share of the No. of Plants	Employment Share	Output Share	LP* in the Base Year Relative to Continuers Base Year	LP* in the End Year Relative to Continuers Base Year	LP* in the End Year Relative to Continuers End Year
1973-1979							
Entering Plant	Domestic	94.67	77.88	68.72		0.82	0.74
	Foreign	5.33	22.12	31.28		1.31	1.18
Exiting Plant	Domestic	91.70	70.57	64.91	0.59		
	Foreign	8.30	29.43	35.09	0.76		
Continuing Plant	Domestic	83.42	58.70	47.50	0.81	0.90	0.81
	Foreign	16.58	41.30	52.50	1.27	1.44	1.29
	All				1.00	1.11	1.00
1979-1988							
Entering Plant	Domestic	95.75	84.61	73.22		0.69	0.60
	Foreign	4.25	15.39	26.78		1.39	1.21
Exiting Plant	Domestic	92.37	73.09	60.04	0.60		
	Foreign	7.63	26.91	39.96	1.08		
Continuing Plant	Domestic	83.83	61.66	52.43	0.85	0.93	0.81
	Foreign	16.17	38.34	47.57	1.24	1.53	1.33
	All				1.00	1.15	1.00
1988-1997							
Entering Plant	Domestic	93.98	79.65	60.47		0.70	0.55
	Foreign	6.02	20.35	39.53		1.80	1.42
Exiting Plant	Domestic	92.31	72.08	60.46	0.59		
	Foreign	7.69	27.92	39.54	1.00		
Continuing Plant	Domestic	87.46	63.04	49.96	0.79	0.93	0.73
	Foreign	12.54	36.96	50.04	1.35	1.94	1.53
	All				1.00	1.27	1.00

Note: The share of exiting plants reflects the share in the base year. The share of entering plants reflects the share in the end year. The share of continuing plants is the share in the base year.
*LP denotes Labour Productivity.

Over the 1980s and 1990s, there has been a shift in employment to small domestic plants. This group is less productive (Baldwin, 1996). The increasing productivity of foreign entrants may therefore be the result almost entirely of reductions in the productivity of domestic rather than the increase in the productivity of foreign entrants. To examine this possibility, we measure the productivity of foreign entrants not against domestic entrants but against the population of continuers.

The productivity of foreign entrants calculated relative to the end-year population of continuers has increased dramatically over time—from 1.18 in 1979 to 1.33 in 1988 to 1.53 in 1997 (Table 5). The adjustments that have been taking place to freer trade over the last quarter century have involved the opening of foreign-controlled plants that are increasingly productive relative to the population as a whole. Nevertheless, part of this may just be the result of domestic plants becoming less productive. When we examine, the relative productivity of foreign entrants to the continuing foreign population (Figure 6), we see that the relative productivity of both groups has grown at about the same pace. The increasing productivity of foreign entrants reflects the overall improvement in the foreign sector.

Foreign-controlled entrants and exiters are much larger than domestic-controlled ones. Figure 5 depicts the relative size of entrants—calculated as the relative output share divided by their relative plant share over the three periods. This difference has increased steadily over the three time periods. But so too has the relative size of plants that were being closed. However the difference between the two has widened in the 1990s relative to the 1980s. Restructuring associated with the dramatic trade liberalization of the 1990s has led the foreign-sector to close down smaller plants than it opened.

The productivity of entering foreign plants is considerably greater than the productivity of foreign exiting plants. The relative position of these two groups compared to continuing plants is depicted in Figure 6 for each of the last three decades. The relative productivity of foreign entrants compared to continuing plants (taken in the terminal year of each period) has increased—as has the relative productivity of the continuing plant of foreign-controlled plants (also calculated in the terminal year of each period). The relative productivity of exits of foreign plants (calculated relative to initial year population) has decreased in the 1990s compared to the 1980s. Freer trade has seen the foreign sector begin to close increasingly less productive plants. The difference between the productivity of new and closed plants has widened in the 1990s, though it has only returned to the levels found in the 1970s.

Figure 3. The Share of Foreign- vs Domestic-Controlled Firms in Plant Turnover, 1988-1997

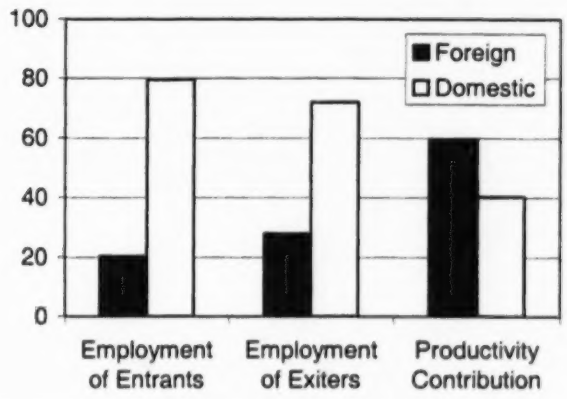


Figure 4. Relative Productivity of Foreign-Controlled to Domestic-Controlled Plants

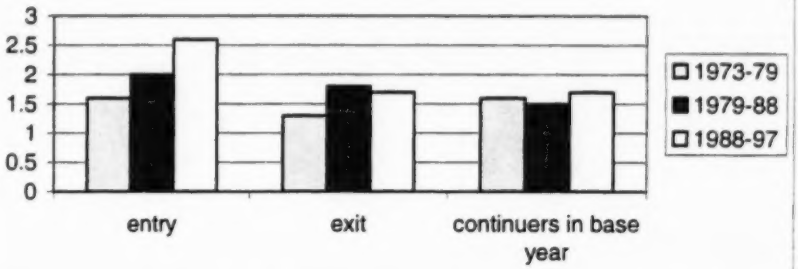
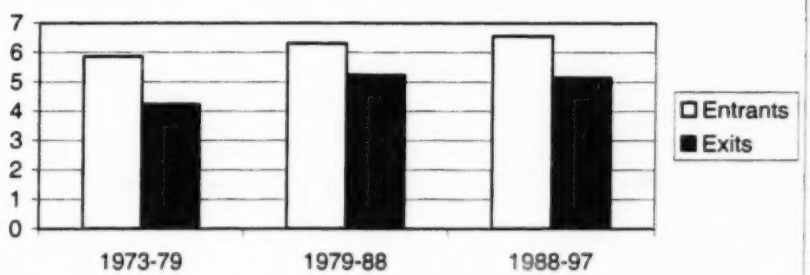
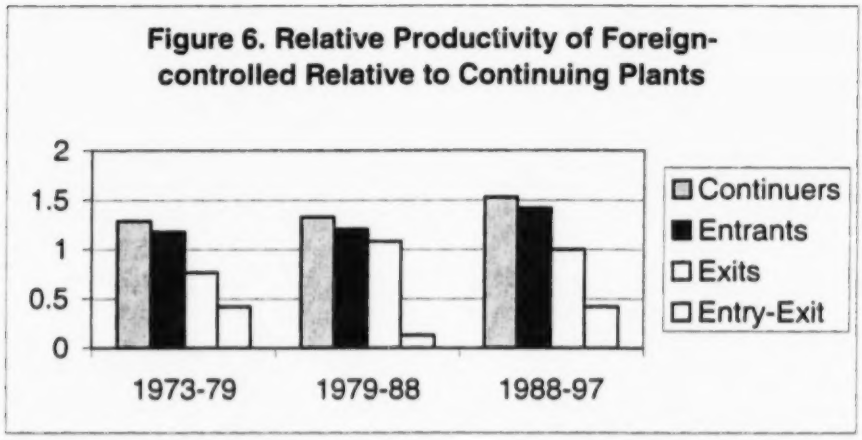


Figure 5. The Relative Output Size of Foreign Compared to Domestic Entrants and Exits





The productivity decompositions that divide plant into domestic and foreign-controlled are presented in Table 6 using the GR method.[17] Plant turnover by foreign-controlled firms is an important source of productivity growth in Canadian manufacturing, as shown in Table 6. During the 1988-1997 period, 12% or 0.35 percentage points per year of the growth in labour productivity is due to foreign-controlled firms opening up and closing down plants. This contribution has been relatively constant over time. While entry and exit together have been less important to productivity growth in more recent decades, this is caused by the decline in the contribution made by the entry and exit of domestic plants.

The contribution of foreign-controlled plant turnover is disproportionately large relative to their employment. As Figure 3 shows, over the 1988-1997 period, foreign-controlled entrants account for 20% of employment of all entering plants and foreign-controlled exiters account for 28% of employment of all exiting plants. But plant turnover of foreign controlled firms represents 60% of the contribution from total plant turnover.[18]

Table 6. Productivity Decomposition in Total Manufacturing—Domestic- vs Foreign-Controlled Plants: GR Approach

Plants	Within-plant	Between-plant	Net Entry	Entry	Exit
1973-79					
Domestic-controlled	24.92	6.95	14.88	1.52	13.36
Foreign-controlled	16.07	25.31	11.88	4.77	7.11
1979-88					
Domestic-controlled	29.07	0.17	8.12	-2.45	10.57
Foreign-controlled	52.54	-2.05	12.14	7.09	5.05
1988-97					
Domestic-controlled	29.24	-3.45	7.78	-4.74	12.52
Foreign-controlled	56.55	-1.64	11.52	6.81	4.71

[17] Table 6 uses gross output per worker as a measure of labour productivity. Table 2 in the appendix reports decomposition results using value added per worker and shows similar results.
[18] The results for the 1973-1979 and 1979-1988 periods are similar.

It is also noteworthy that the growth from within-plant component is considerably higher in the foreign sector in the last two decades. It has gone from about 41% of the total in the 1970s to over 55% of the total in the 1990s. And it has become increasingly concentrated in the within-plant segment—that is, it is caused by productivity growth holding shares constant, rather than shifts in employment share towards more productivity plants. The latter was more important in the 1970s.

In summary, foreign-controlled plants have become increasingly important as a source of entry. They have become increasingly large relative to domestic entrants. They have become increasingly productive relative to both domestic entrants and relative to incumbents. The latter increase was particularly large in the period post FTA and NAFTA. Finally, the contribution that foreign plant turnover from entry and exit relative to domestic turnover is large and growing over the period.

6.3 Plant Turnover Among Single-Plant vs. Multi-Plant Firms

To this point, we have examined the effect of plant entry and exit. New plants may be associated with entirely new firms, or with existing firms. New plants that are associated with the arrival of new firms are generally new plants associated with single plant firms.[19] New plants that are associated with multi-plant firms either are new plants of firms already in a particular industry, or are created by firms that are in other industries and fall into the experienced-entry category (de alio as opposed to de novo entry). Disney, Haskel and Heden (2000) find that, for the UK manufacturing sector over the 1980-1992 period, much of the contribution of plant turnover to productivity growth is due to multi-plant firms starting up and closing down plants. In this section, we divide new plants into those owned by single plant firms and those associated with multi-plant firms and measure the contribution that plant turnover in each group makes to total productivity growth.

In 1997, multi-plant firms produced 75% of output and employed 60% of workers in Canadian manufacturing. The plants that are part of multi-plant firms accounted for 22% of all plants.

Plants opened up or closed down by multi-plant firms represent an important part of plant turnover in Canadian manufacturing (as shown in Table 7). The entrants and exiters of multi-plant firms account for 10% to 15% of the number of entrants or exiters in Canadian manufacturing, 35% to 50% of employment, and 50% to 70% of output. The entrants and exiters of multi-plant firms are much larger than the entrants and exiters of single-plant firms, as reflected in the higher employment or output shares of the entrants and exiters of multi-plant firms.

[19] Except in the rare circumstance where a new firm enters by simultaneously building more than one plant in the same year.

Table 7. Plant Turnover and Productivity Differentials in Total Manufacturing, Single- vs Multi-plant Firm

		Share of the Number of Plants	Employment Share	Output Share	LP* in the Base Year Relative to Continuers Base Year	LP* in the End Year Relative to Continuers Base Year	LP* in the End Year Relative to Continuers End Year
1973-1979							
Entering Plant	Single	89.62	57.73	39.35		0.63	0.57
	Multi	10.38	42.27	60.65		1.33	1.20
Exiting Plant	Single	83.80	47.44	39.17	0.53		
	Multi	16.20	52.56	60.83	0.74		
Continuing Plant	Single	67.95	24.27	15.51	0.64	0.70	0.63
	Multi	32.05	75.73	84.49	1.12	1.25	1.13
	All				1.00	1.11	1.00
1979-1988							
Entering Plant	Single	90.10	66.67	47.96		0.57	0.50
	Multi	9.90	33.33	52.04		1.25	1.09
Exiting Plant	Single	85.37	49.62	34.89	0.51		
	Multi	14.63	50.38	65.11	0.94		
Continuing Plant	Single	65.19	22.31	13.96	0.63	0.68	0.59
	Multi	34.81	77.69	86.04	1.11	1.33	1.16
	All				1.00	1.15	1.00
1988-1997							
Entering Plant	Single	84.86	64.85	44.95		0.64	0.50
	Multi	15.14	35.15	55.05		1.45	1.14
Exiting Plant	Single	84.05	47.71	32.35	0.48		
	Multi	15.95	52.29	67.65	0.92		
Continuing Plant	Single	73.79	30.37	17.97	0.59	0.72	0.57
	Multi	26.21	69.63	82.03	1.18	1.58	1.24
	All				1.00	1.27	1

Note: The share of exiting plants reflects the share in the base year. The share of entering plants reflects the share in the end year. The share of continuing plants is the share in the base year.
*LP denotes Labour Productivity.

The entering plants of multi-plant firms are more productive than the entering plants of single-plant firms. The plants that entered in the 1988-1997 period that belong to multi-plant firms are more than twice as productive as those that belong to single-plant firms.

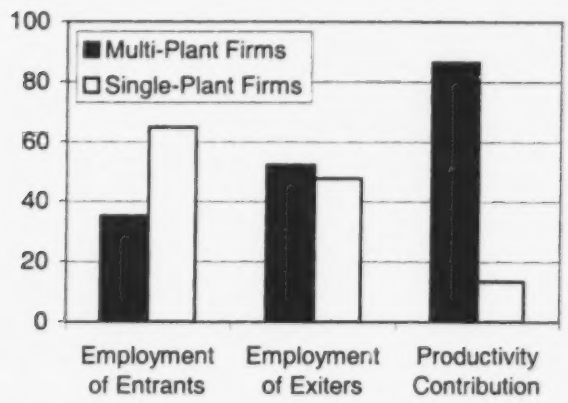
Table 7 also shows that continuing plants that are part of multi-plant firms are more productive than the plants that are part of single-plant firms and the gap is widening. The percentage difference in labour productivity between them increased from 100% in 1988 to 120% in 1997.

Comparison of the relative productivity of entrants and exits in multi-plant as opposed to single-plant firms indicates that there are substantial differences between the new and the closed plants in the first group, but not in the second, in most of the periods.

Almost all of the contribution of plant turnover to productivity growth is due to more productive new plants of multi-plant firms displacing exiting plants of these firms that are less productive (Table 8). Figure 7 shows that the net contribution from plant turnover of multi-plant firms is disproportionate relative to their employment share. The contribution of plant turnover due to multi-plant firms opening up or closing down plants exceeds their shares of employment.

It is also noteworthy that the continuing plant contribution of multi-plant firms greatly exceeds that of single-plant firms (Table 8). A remarkable feature then of productivity growth in Canadian manufacturing, is the predominant role of multi-plant firms. Multi-plant firms account for almost all of the productivity growth in Canadian manufacturing in the three periods we examined. Multi-plant firms account for 85% of growth in labour productivity in the 1973-1979 period and more than 90% of growth in the 1979-1988 and 1988-1997 periods. The contribution of multi-plant firms to productivity growth is much greater than their share of employment would suggest.[20]

Figure 7. The Share of Multi- vs Single-Plant Firms in Plant Turnover, 1988-1997



[20] Multi-plant firms account for 60% to 70% of employment in aggregate manufacturing in the three periods.

Table 8. Productivity Decomposition in Total Manufacturing—Single- vs Multi-plant Firm: GR Approach

Plants	Within-plant	Between-plant	Net Entry	Entry	Exit
1973-1979					
Single-plant firm	-13.27	21.50	6.16	-4.57	10.73
Multi-plant firm	54.19	11.06	20.36	10.51	9.85
1979-1988					
Single-plant firm	4.99	-1.41	0.29	-9.38	9.67
Multi-plant firm	77.55	-0.50	19.07	12.68	6.39
1988-1997					
Single-plant firm	8.90	-2.82	2.52	-7.38	9.90
Multi-plant firm	77.55	-2.40	16.25	8.52	7.73

7. Plant Turnover and Productivity Growth at Industry-level Manufacturing

In previous sections, we have focused on the aggregate manufacturing sector when examining entry and exit and its contribution to productivity growth. The broad overview that this provides hides important differences at the industry level that serve to help us understand the forces that generate productivity growth.

In this section, we examine plant turnover and productivity growth in 22 manufacturing industries at the 2-digit SIC level. Appendix Tables 1, 2 and 3 contain plant turnover and productivity for entering, exiting and continuing plants at the 2-digit level over the 1973-1979, 1979-1988 and 1988-1997 periods. At issue is the extent to which there are discernible patterns in the differences of turnover and productivity growth at the industry level and whether these differences are relatively constant or change over time.

If the differences are constant, this would indicate that basic structural differences (i.e., market structure) dominate explanations of the impact of entry and exit because these characteristics change very little over time. If the interindustry pattern changes considerably over time, then a changing macroeconomic environment associated with business cycles, changes in the trade environment, or changes in technology which suddenly give entrants an advantage over incumbents and lead to more entry, are likely to play larger roles.

We also examine whether differences in plant turnover and its contribution to productivity growth are more concentrated in more innovative industries. Plant turnover is often perceived to be more rapid and the contribution of plant turnover to productivity more important in the information communication technology-related industries. In order to test this proposition, we examine differences in plant turnover and productivity growth between the core-manufacturing sector that produces more innovations and the remaining industries in the manufacturing sector.[21]

[21] There are other potential explanations for cross-industrial differences in plant turnover and productivity growth. The most important perhaps relates to entry and exit barriers including: openness to domestic and international competition as conditioned by trade barriers and industry regulation, capital and financing requirements of entry, and economies of scale.

7.1 Patterns of Entry and Exit at the 2-digit level

Overall, the findings at the 2-digit level are consistent with those for total manufacturing. First, a large amount of plant turnover takes place in all manufacturing industries. During the 1988-1997 period, the number of entering plants calculated as a share of total number of plants ranges from a low of 22% in Tobacco to a high of 50% in Refined Petroleum and Coal Products. The share of exiting plants ranges from 26% in Tobacco to 64% in Clothing. Second, entering plants are more productive than exiting plants in most manufacturing industries.

The large amount of plant turnover, combined with productivity differentials between entering and exiting plants, have a positive and significant impact on productivity growth in almost all manufacturing industries, as shown in Appendix Tables 4, 5 and 6. Plant turnover contributes positively to labour productivity in 21 of the 22 industries between 1973-1979, in 18 of the 22 industries between 1979-1988, and in 20 of the 22 industries between 1988-1997. On average, the net entry component contributes 0.5 percentage points of the 2.2% annual growth in labour productivity in the 1973-1979 period, 0.2 percentage points of the annual 1.4% growth in the 1979-1988, and 0.5 percentage points of the 2.7% annual growth in the 1988-1997 period.

While entry and exit make an important contribution to the total growth in productivity, it must nevertheless be recognized that it is not the most important component contributing to productivity growth. Moreover, overall productivity growth is not larger when the proportion that net entrants contribute is larger. The correlation between the proportion contributed by net entry and the average productivity growth rate in a particular period is negative not positive. It is -0.29 for the 1970s, -0.01 for the 1980s, and -0.08 for the 1990s. Entry is important but we should not lose sight of the fact that it is not the dominant force driving productivity growth in an industry.

Nevertheless, the determinants of the inter-industry differences in the contribution that net entry makes are still of interest. The importance of the net entry component depends upon the relative size of entrants (their employment share) and the difference between the relative productivity of entrants and exits.

To test the stability of the inter-industry differences in entry and exit over time, we examine the correlations at the industry level across time. Here, there is substantial stability over adjacent time periods. Using employment shares, the correlation of industry entry rates between the 1970s and 1980s is 0.89; between the 1980s and 1990s, it is 0.85. For exits, the correlations are 0.75 and 0.68, respectively. Over a longer period, there is evidence of more change in inter-industry differences since the correlation between the 1970s and 1990s for entry and exit falls to 0.76 and 0.62, respectively.

The industry changes in entry and exit that occur over the two decades do not move continuously in the same direction. The correlation between the changes in employment entry rates between the 1970s and 1980s with the changes between the 1980s and 1990s is -0.72. Industries that saw an increase in entry rates between the first and second periods saw less of an increase or a decline between the second and third periods. This is less true of employment exit rates where the same correlation was also negative but only -0.17.

What is it that determines the relative importance of entry and exit in terms of market share? Here theories have concentrated on market structure such as barriers to entry, on the ease of post-entry growth, and on disequilibrium conditions associated with above average profitability. This section is not intended to provide an exhaustive test of these alternatives. But we do find that the conditions that allow entrants to become large compared to incumbents are closely related to the ultimate importance of turnover, as measured by employment share. The relative employment size of entrants and exits is strongly correlated with the employment share of entry and exit (0.80, 0.97, and 0.96 for entry and 0.89, 0.86, and 0.86 for exit in the three respective periods).

The other variable that strongly influences the contribution that is made by the entry of new plants and the exit of old plants is the productivity of each group relative to continuers or relative to one another. This variable will be determined by the ability of new plants to adopt new technologies relative to existing firms. In turn, this will be a function of the extent to which new technologies are best introduced into a new environment, or the extent to which the new technologies are best combined with other technologies in existing plants.

To test the stability of the inter-industry differences in relative labour productivity over time, we examine the correlations at the industry level across time periods. Here, there is much less stability over adjacent time periods than there was for entry and exit rates. The correlations of industry entry and exit relative productivity to continuers between the 1970s and 1980s are 0.18 and 0.27, respectively. Over a longer period, there is evidence of more change in inter-industry differences since the correlation between the 1970s and 1990s for entry and exit falls to -0.01 and 0.31, respectively. For the 1980s and 1990s, these correlations increase to 0.73 and 0.55, respectively. If we examine, the correlations in the difference in relative productivity between entrants and exits, the same pattern emerges. The correlations between the differences for the 1970s and 1980s is -0.22 and for the 1970s and 1990s, it is -0.30. But it is 0.78 between the 1980s and 1990s. The 1970s then appear to be quite different from the 1980s and 1990s. There are more similarities between the 1980s and 1990s.

Contrary to our earlier results for the relationship between average relative size of entrants and entry rates, there is very little correlation between average size and relative productivity. For entry, the correlations are -0.33, 0.01 and 0.21 for the three time periods. Whatever allows entrants to obtain a relatively large stature compared to incumbents is not closely related to the underlying technological characteristics that allow new plants to have higher productivity than incumbents.

Do entry and exit contribute the same proportion to productivity growth over time? The high correlations between employment entry and exit shares over time and the low correlations between the relative labour productivity of entrants results in virtually no connection between the contributions made by net entry at the industry level. These correlations are 0.001 between the 1970s and 1980s and -0.01 between the 1970s and 1990s. They are slightly higher, but still small (0.29), between the 1980s and 1990s.

This suggests that explanations of the importance of the contribution made by entry to productivity growth should focus on factors that change over time. In the next section, we examine one change that has occurred in the environment.

7.2 Plant Turnover and Trade Liberalization

What are the influences that may cause the inter-industry entry pattern to change over time? They include changes in structural conditions like entry barriers, changing technologies, and major shifts in the environment.

Changes in trade are one exogenous environmental influence that may affect entry and exit. There is no unambiguous effect to be expected from increases in trade intensity. To the extent that an increase in imports reduces profitability, it should reduce entry and increase exit, while an increase in exports may reduce exit and increase entry for the opposite reason. But more complex models yield ambiguous predictions about the effect of trade liberalization. Increases in trade may be accompanied by less entry if existing plants begin to exploit scale economies by internal expansion. Increases in two way intra-industry trade may be accompanied by specialization that may require the building of new plants to handle a different product line. In this case, an increase in imports that is simultaneous with increases in exports will lead to more entry. In this section, we investigate the actual relationship that exists between plant turnover in the Canadian manufacturing sector and changes in trade patterns that have taken place.

Over the period under study, there have been dramatic changes in trade intensity (Table 9). Imports as a percentage of domestic disappearance[22] have gone from 18% in 1973 to 39% in 1997 in an average two-digit industry. At the same time, export intensity has increased from 22% to 42%. Some industries have become more export intensive; others have become more import intensive—but the effect has been relatively small. The mean of the absolute differences between import and export intensity has gone up relatively little. Most of the time, there have been simultaneous increases in both imports and exports. The measure of intra-industry trade has more than doubled.

Table 9. Changes in Trade Intensity (average 2-digit values)

	Import intensity	Export intensity	Absolute value of export minus import intensity	Intra-industry trade
1973	18	22	14	26
1979	22	26	15	33
1988	23	28	16	35
1997	39	42	16	65

Notes:
1) Import intensity equal imports over imports plus domestic shipments minus exports.
2) Export intensity is exports divided by domestic shipments.
3) Intra-industry trade intensity is export intensity plus import intensity minus the absolute value of export minus import intensity.
4) Shipments are defined as total shipments from manufacturing plants.

[22] Domestic disappearance is defined as imports plus domestic shipments minus exports.

We investigate how entry and exit is related to changing trade patterns in two ways. First, we ask how entry, exit and net entry (the difference between entry and exit) are related in each period to changes in import and export intensity and to changes in the measure of intra-industry trade intensity (Table 10). We expect these correlations to be weak because most of the cross-industry differences should be affected by structural differences.[23]

Table 10. Correlations Between Entry, Exit, Net Entry and Changes in Trade Intensity

	Changes in import intensity	Changes in export intensity	Changes in intra-industry trade
Entry			
1973-79	.04	.31	.10
1979-88	.02	-.13	-.14
1988-97	.45	.24	.31
Exit			
1973-79	-.25	.09	-.29
1979-88	-.11	.19	-.16
1988-97	.48	.46	.34
Net Entry			
1973-79	.31	.24	.42
1979-88	-.10	.13	.06
1988-97	-.26	-.37	-.19

There is a considerable difference in the relationship between changes in trade and the amount of entry and exit in the two earlier periods. In the 1970s, increases in exports are associated with more entry; increases in imports are associated with less not more exit, and both are associated with higher amounts of net entry. By the 1990s, the relationship between imports and exits has changed. Now increases in imports are significantly associated with more exits; as before, increases in exports are still associated with more entry, but the relationship is more significant. Increases in intra-industry trade lead to both more entry and exit. However, the effect of exit offsets the effect on entry and on balance there is less net entry where imports, exports, and intra-industry trade are increasing.

Second, we examine whether the increases in entry between each decade are related to increases in trade intensity between periods (Table 11). Here we ask whether the first difference of the trade change across decades (the increase in export intensity of 1979-88 minus the increase in the export intensity during 1973-79) is associated with a change in the rate of entry between two decades (the entry rate in the 1980s minus the entry rate in the 1970s).

Between the 1970s and 1980s, increases in export intensity led to lower entry, though the result is not significant. This effect is even larger and very significant between the 1980s and the 1990s. Between the 1970s and 1980s, there are few significant relationships between changes in trade intensity and exit. But between the 1980s and 1990s, increases in export intensity lead to more exits. The net effect is that changes in intra-industry trade lead to less gross entry and less

[23] See Geroski and Schwalbach (1991) for a set of entry studies.

net entry. Increases in the export intensity associated with trade liberalization have brought about significantly less entry and slightly more exit.[24]

In summary, increases in trade liberalization have been accompanied by growth in intra-industry trade. Where this growth was largest, both entry and exit have declined; but the entry rate has fallen more than the exit rate as intra-industry trade has increased.

Table 11. Correlations Between Entry, Exit, Net Entry and Changes in Trade Intensity

	Changes in import intensity	Changes in export intensity	Changes in intra-industry trade
Entry			
1970s-80s	-0.01	-0.22	-0.20
1980s-90s	-0.50	-0.40	-0.43
Exit			
1970s-80s	-0.11	0.19	-0.26
1980s-90s	0.15	0.40	0.14
Net Entry			
1970s-80s	0.09	-0.39	0.04
1980s-90s	-0.43	-0.59	-0.37

7.3 Patterns of Entry and Exit in Innovative Industries

To some observers, high-technology industries appear to be more dynamic than others. In this section, we investigate whether this dynamism extends to the amount of plant turnover and the extent to which entry contributes more here than elsewhere to productivity growth.

To examine these issues, we adopt a taxonomy that aggregates industries into three broad groups that differ in terms of their use of research and development and the intensity of innovation in each—the core, secondary and tertiary 'other' sectors.[25] We then aggregate the results at the 4-digit level to these three broad sectors, using each industry's employment shares, averaged over the beginning and ending years of a period, as weights.

The core sector is more R&D intensive, creates more innovations than it uses, and distributes some of its innovations downstream to the secondary and tertiary 'other' sector in the form of machinery and equipment or new materials. The secondary sector is second in terms of its R&D intensity and the intensity of innovation. The tertiary 'other' sector ingests innovations from the other sectors.[26]

[24] We also correlated entry and exit rates with the absolute value of the difference between export and import intensity. There was no significant relationship here for the period between the 1980s and 1990s.
[25] This taxonomy comes from Robson, et al., 1988.
[26] See Baldwin and Hanel (2002) for a detailed analysis of the differences in the innovation regimes of these three sectors.

The core sector includes ICT-related industries (Machinery and Electrical & Electronic Products) and Chemicals industries.[27] The secondary sector includes Rubber & Plastics, Primary Metals, Fabricated Metals, Transportation Equipment and Non-Metallic Minerals industries. The rest of the manufacturing industries are classified as the tertiary "other" sector.

As postulated, plant turnover is a more important source of productivity growth in the core sector than in the rest of manufacturing sector in the 1980s and 1990s (Table 12), but the differences are not large. Between 1988 and 1997, plant turnover contributed 21% of the annual productivity growth in the core sector, compared with 18% of the annual growth in each of the secondary and other sectors. Plant turnover is also found to be more important for productivity growth in the core sector in the 1979-1988 period. However, during the 1973-1979 period, plant turnover is more important in the tertiary 'other' sector, accounting for more than 30% of its labour productivity growth.

Table 12. Productivity Decomposition by Industrial Sector

Industrial Sector	LP Growth	Within-plant	Between-plant	Net Entry	Entry	Exit
1973-1979						
Core	3.00	64.19	12.42	23.39	9.51	13.87
Secondary	1.63	76.36	7.05	16.59	4.76	11.83
Other	2.15	55.92	13.37	30.71	5.14	25.57
1979-1988						
Core	1.91	84.93	-11.53	26.60	10.07	16.53
Secondary	1.91	90.83	-2.35	11.52	3.86	7.66
Other	1.36	77.26	0.26	22.48	2.02	20.47
1988-1997						
Core	5.17	76.95	2.15	20.90	0.23	20.68
Secondary	3.05	90.98	-8.77	17.79	4.65	13.14
Other	1.74	89.02	-6.96	17.94	-4.62	22.56

Note: Labour Productivity (LP) Growth is annual percentage point growth in labour productivity.

When we further examine the differences between the core, secondary and other sectors with regards to the size of entry and exit, we also find that there are few differences between the core and the other sectors (Table 13). After 1979, plant turnover (as measured by employment shares of entering and exiting plants) was somewhat higher in the core sector (55%) than in the rest of manufacturing—though the tertiary 'other' sector was a close second at 50%. What really distinguishes the core sector during the 1988-1997 period was that the employment share of exiters was highest; the employment share of entrants was similar across the three sectors. Between 1979 and 1988, the employment share of entrants was highest in the core sector, while the share of exiters in the core sector was higher than in the secondary sector but similar to the tertiary 'other' sector. In the 1973-1979 period, no apparent differences in plant turnover exist between the core, secondary and other sectors.

[27] We have excluded Refined Petroleum & Coal Products from the core sector as labour productivity in this industry is subject to large fluctuations due to changes in commodity prices.

In summary, the evidence supports the notion that in the core innovative sector, plant turnover is more important than elsewhere—both in terms of its size and its contribution to productivity growth. But set against this is the finding that the differences with other sectors are not large.

Table 13. Plant Turnover by Industrial Sector

Industrial Sector	Entering plants		Exiting plants	
	The share of number of plants	Employment share	The share of number of plants	Employment share
1973-1979				
Core	39.30	13.55	21.70	11.46
Secondary	42.10	11.56	26.18	8.60
Other	36.86	11.98	31.52	14.40
1979-1988				
Core	58.16	24.35	42.01	22.70
Secondary	56.12	21.90	43.77	15.45
Other	57.95	22.91	49.68	23.46
1988-1997				
Core	40.16	20.97	43.92	33.58
Secondary	38.38	21.81	40.29	21.75
Other	38.53	20.10	50.12	29.97

Note: The share of exiting plants reflects the share in the base year. The share of entering plants reflects the share in the end year.

8. Conclusion

In this paper, we examine the effect of plant turnover on labour productivity growth in Canadian manufacturing over the 1973-1979, 1979-1988 and 1988-1997 periods. We find that productivity growth within continuing plants is the predominant source of productivity growth. But plant turnover also makes a contribution as more productive entrants replace exiting plants that are less productive. It contributes 15% to 25% of labour productivity growth during the 1973-1979, 1979-1988 and 1988-1997 periods. This contribution is consistently larger than the share of employment in entrants and exits.

Not all entrants are equally important. A disproportionately large fraction of the contribution from plant turnover is due to foreign-controlled firms or multi-plant firms opening up and closing down plants. The plants opened up by foreign-controlled or multi-plant firms are much more productive that other entrants. This finding reinforces other research (Baldwin and Dhaliwal, 2000) that showed foreign plants to have a higher productivity than domestic plants and to be increasing this differential over the last three decades. This paper shows that the difference between foreign and domestic plants is particularly marked for entrants.

Equally important, it reinforces our earlier finding that small domestic plants have not been the engine behind growth (Baldwin, 1998). The proportion of productivity growth that is accounted for by entry has been relatively constant over the last three decades. But the share of this that comes from domestic plants has fallen over this period.

Entering plants undergo both a selection and learning process. Entrants with relatively high productivity and large size are more likely to survive. And the surviving members of entering plants experience growth in labour productivity, employment and output. We find that output and employment grow more quickly for surviving entrants than for incumbent plants. However, the productivity growth of the surviving entrants is slower than that of incumbents. New plants learn but not as quickly as continuing plants.

Plant turnover is an important source of labour productivity growth in almost all manufacturing industries. But the cross-industry pattern of the contribution that entrants make has changed over time. Some of this is due to trade liberalization that has affected the amount of entry and exit at the industry level. But more has come from changes in the relative productivity of new plants—which is probably the result of changes in technology. Finally, in the 1980s and 1990s, plant turnover appears to be a more important source of productivity growth in the ICT-related and Chemicals industries than in the rest of manufacturing.

Appendix

Table A1. Decomposition of Productivity (Valued Added per Worker) in Total Manufacturing

	LP growth	Within-plant	Between-plant	Cross-plant	Net entry	Entry	Exit
FHK							
1973-1979	2.00	78.12	23.04	-22.57	21.41	5.15	16.26
1979-1988	1.13	103.18	9.14	-32.78	20.45	-1.48	21.94
1988-1997	2.47	93.04	8.83	-19.22	17.35	8.20	9.15
GR							
1973-1979	2.00	66.78	11.02	--	22.20	-0.56	22.76
1979-1988	1.13	86.83	-6.61	--	19.79	-9.06	28.84
1988-1997	2.47	83.36	-4.51	--	21.15	-0.29	21.44
Baldwin v1							
1973-1979	2.00	78.27	23.94	-22.61	20.40	--	--
1979-1988	1.13	103.06	7.59	-32.74	22.09	--	--
1988-1997	2.47	93.10	10.25	-19.24	15.89	--	--
Baldwin v2							
1973-1979	2.00	66.96	12.63	--	20.40	--	--
1979-1988	1.13	86.69	-8.78	--	22.09	--	--
1988-1997	2.47	83.48	0.63	--	15.89	--	--

Note: Labour productivity (LP) is defined as real value added per worker.

Table A2. Decomposition of Productivity (Value Added per Worker) in Total Manufacturing—Domestic- vs Foreign-Controlled Plants: GR Approach

Plants	Within-plant	Between-plant	Net Entry	Entry	Exit
1973-1979					
Domestic-controlled	18.89	4.64	11.68	-4.57	16.25
Foreign-controlled	46.53	6.12	12.14	4.86	7.28
1979-1988					
Domestic-controlled	27.44	-0.28	5.33	-16.18	21.51
Foreign-controlled	57.16	-6.23	16.58	9.46	7.12
1988-1997					
Domestic-controlled	28.04	-3.32	9.57	-7.77	17.34
Foreign-controlled	54.05	-1.03	12.70	8.97	3.73

Note: Labour productivity is defined as real value added per worker.

Table A3. Plant Turnover and Productivity Differentials by Industry, 1973-1979

Industry	Share of the Number of Plants		Employment Share		Relative LP		
	Entrants	Exits	Entrants	Exits	Entrants	Exits	Continuer
Food	26.90	32.51	8.13	13.36	1.10	0.77	1.09
Beverage	10.14	28.41	3.50	9.37	0.76	0.48	1.00
Tobacco	26.92	24.00	2.55	14.50	1.61	0.48	1.23
Rubber	34.75	15.38	3.48	3.60	1.02	1.10	1.16
Plastic	44.65	22.41	20.88	11.56	1.12	0.85	1.09
Leather and Allied	33.92	23.77	13.03	16.97	1.04	0.92	1.23
Primary Textile	25.70	31.76	9.99	17.09	1.11	0.70	1.29
Textile Products	33.64	27.67	10.92	13.48	0.95	0.90	1.22
Clothing	34.24	32.75	17.44	20.44	1.14	0.82	1.23
Wood	44.28	36.16	16.76	18.27	1.05	0.78	1.09
Furniture and Fixture	42.86	31.35	17.20	20.20	0.91	0.91	1.02
Paper and Allied Products	22.01	14.92	3.90	4.11	1.04	0.65	1.05
Printing, Publishing &Allied	41.38	31.56	13.70	13.45	1.05	0.81	1.16
Primary Metal	24.95	17.10	5.69	1.96	1.68	0.99	1.08
Fabricated Metal Products	43.16	25.89	17.17	12.44	1.07	0.73	1.00
Machinery	41.57	18.51	13.64	7.03	1.11	0.87	1.11
Transportation Equipment	44.89	33.17	10.22	9.51	0.71	0.55	1.12
Electrical and Electronic	45.44	24.88	16.34	15.34	1.03	0.69	1.12
Non-metallic Mineral	41.03	26.94	12.50	10.79	1.02	0.87	1.11
Refined Petroleum and Coal	24.32	20.00	10.74	6.79	0.91	0.63	1.02
Chemical	30.39	22.24	9.32	9.22	1.39	0.65	1.16
Other Manufacturing	45.12	30.35	17.80	13.70	0.92	0.86	1.13
Simple Average	33.14	24.86	11.08	11.44	1.03	0.74	1.07

Note: The relative labour productivity (LP) is defined as output per worker relative to that of continuing plants in 1973. The share of exiting plants reflects the share in the base year. The share of entering plants reflects the share in the end year.

Table A4. Plant Turnover and Productivity Differentials by Industry, 1979-1988

Industry	Share of the Number of Plants		Employment Share		Relative LP		
	Entrants	Exits	Entrants	Exits	Entrants	Exits	Continuer
Food	41.24	50.37	14.70	20.06	0.92	0.87	1.09
Beverage	23.59	37.10	4.76	16.74	0.73	0.58	1.09
Tobacco	10.53	34.62	2.21	23.83	0.10	0.93	1.44
Rubber	51.11	30.16	11.89	9.98	1.04	1.00	0.93
Plastic	58.89	41.49	32.04	19.30	0.96	0.75	1.11
Leather and Allied	47.80	51.78	15.26	29.69	1.15	0.89	0.97
Primary Textile	40.00	40.28	12.79	26.91	1.34	0.69	1.24
Textile Products	60.98	49.67	30.93	22.65	0.82	0.77	1.09
Clothing	60.50	53.15	32.19	38.18	0.93	0.83	1.04
Wood	59.63	51.99	27.31	24.57	1.16	0.85	1.39
Furniture and Fixture	68.70	54.44	33.69	30.91	0.82	0.82	1.03
Paper and Allied Products	33.57	26.47	7.54	6.47	1.10	0.76	1.24
Printing, Publishing &Allied	62.09	46.41	28.93	20.42	0.91	0.79	1.06
Primary Metal	37.58	32.29	11.35	5.89	1.50	0.71	1.16
Fabricated Metal Products	59.00	45.49	32.05	28.49	0.80	0.95	1.13
Machinery	62.33	43.58	32.12	31.17	0.87	0.94	1.08
Transportation Equipment	56.88	45.22	18.02	11.18	0.84	0.53	1.33
Electrical and Electronic	61.17	45.22	23.61	21.13	1.06	0.95	1.34
Non-metallic Mineral	48.96	43.28	23.38	18.40	0.79	0.80	1.02
Refined Petroleum and Coal	41.79	29.73	13.72	23.56	0.45	0.86	0.95
Chemical	48.33	36.87	17.18	15.38	1.45	0.73	1.14
Other Manufacturing	66.42	53.43	35.46	33.53	0.85	0.76	1.01
Simple Average	47.87	41.00	20.05	20.80	0.90	0.77	1.08

Note: The relative labour productivity (LP) is defined as output per worker relative to that of continuing plants in 1979. The share of exiting plants reflects the share in the base year. The share of entering plants reflects the share in the end year.

Table A5. Plant Turnover and Productivity Differentials by Industry, 1988-1997

Industry	Share of the Number of Plants		Employment Share		Relative LP		
	Entrants	Exits	Entrants	Exits	Entrants	Exits	Continuer
Food	35.50	39.51	18.40	25.69	0.89	0.89	1.14
Beverage	43.65	60.92	11.11	40.66	0.77	0.72	1.51
Tobacco	22.22	26.32	2.57	9.79	0.14	0.94	1.27
Rubber	41.86	33.16	20.79	22.28	1.45	0.93	1.40
Plastic	37.55	36.71	25.01	21.37	0.89	0.90	1.15
Leather and Allied	35.24	62.33	18.54	50.76	0.88	0.81	1.03
Primary Textile	28.32	43.12	11.70	23.04	1.12	1.01	1.34
Textile Products	40.27	53.91	20.59	38.29	0.85	0.87	1.15
Clothing	38.83	63.76	20.51	47.05	1.28	0.92	1.17
Wood	36.40	47.38	20.95	26.27	0.88	0.72	1.10
Furniture and Fixture	41.81	59.84	25.10	45.49	1.05	0.90	1.26
Paper and Allied Products	28.57	30.50	10.62	8.60	1.26	0.72	1.24
Printing, Publishing &Allied	39.74	48.49	22.87	26.82	0.81	0.87	0.88
Primary Metal	26.79	33.87	6.36	7.60	1.51	0.76	1.40
Fabricated Metal Products	39.10	40.46	27.92	31.52	0.90	0.86	1.06
Machinery	39.17	42.91	22.72	33.17	1.05	0.99	1.35
Transportation Equipment	41.24	47.62	22.35	20.28	1.09	0.64	1.38
Electrical and Electronic	42.58	46.96	19.34	36.05	1.62	0.98	2.47
Non-metallic Mineral	36.60	37.80	21.62	26.97	0.93	0.77	1.16
Refined Petroleum and Coal	50.00	31.58	15.54	18.59	0.41	0.74	1.49
Chemical	38.97	42.00	21.22	29.95	1.02	0.71	1.21
Other Manufacturing	42.62	50.51	31.43	36.55	0.98	0.91	1.17
Simple Average	35.96	42.59	18.14	27.25	0.95	0.81	1.23

Note: The relative labour productivity (LP) is defined as output per worker relative to that of continuing plants in 1988. The share of exiting plants reflects the share in the base year. The share of entering plants reflects the share in the end year.

Table A6. Productivity Decomposition by Industry, 1973-1979 GR Approach

	LP Growth	Within-plant	Between-plant	Net entry	Entry	Exit
Food	1.96	0.79	0.33	0.84	0.19	0.65
Beverage	0.63	-0.25	0.56	0.32	0.01	0.30
Tobacco	4.93	3.22	0.42	1.29	-0.05	1.34
Rubber	2.27	2.95	-0.69	0.01	0.03	-0.02
Plastic	1.80	0.96	0.23	0.61	0.25	0.36
Leather and Allied	3.38	2.56	0.34	0.48	0.11	0.37
Primary Textile	4.88	3.59	0.24	1.04	0.04	1.00
Textile Products	3.15	2.61	0.24	0.30	-0.02	0.32
Clothing	3.83	2.24	0.48	1.10	0.51	0.59
Wood	1.99	1.13	0.01	0.86	0.13	0.73
Furniture and Fixture	0.26	-0.40	0.63	0.03	-0.10	0.14
Paper and Allied Products	1.03	0.71	0.04	0.29	0.06	0.22
Printing, Publishing &Allied	2.73	2.06	0.23	0.44	-0.10	0.54
Primary Metal	1.81	0.91	0.31	0.59	0.63	-0.04
Fabricated Metal Products	0.84	0.00	0.17	0.67	0.36	0.31
Machinery	1.86	1.30	0.29	0.27	0.07	0.20
Transportation Equipment	1.99	1.92	0.19	-0.11	-0.30	0.19
Electrical and Electronic	2.48	1.81	0.08	0.59	0.21	0.38
Non-metallic Mineral	1.77	1.94	-0.44	0.28	-0.12	0.40
Refined Petroleum and Coal	0.61	-11.27	11.63	0.24	-0.17	0.41
Chemical	3.38	1.90	0.59	0.89	0.41	0.49
Other Manufacturing	1.77	1.32	0.29	0.16	0.04	0.12
Simple Average	2.24	1.00	0.74	0.51	0.10	0.41

Note: Annual percentage point growth in labour productivity (LP).

Table A7. Productivity Decomposition by Industry, 1979-1988 GR approach

	LP Growth	Within-plant	Between-plant	Net entry	Entry	Exit
Food	1.02	0.64	0.16	0.22	0.00	0.22
Beverage	1.64	1.33	-0.09	0.40	-0.10	0.50
Tobacco	4.01	3.43	0.24	0.33	-0.29	0.62
Rubber	-0.69	-1.01	0.16	0.16	0.17	-0.01
Plastic	1.16	1.10	-0.23	0.29	0.02	0.28
Leather and Allied	0.35	0.01	-0.19	0.53	0.13	0.40
Primary Textile	3.46	3.38	-1.21	1.28	0.37	0.91
Textile Products	0.64	0.52	-0.07	0.19	0.01	0.18
Clothing	0.84	0.47	-0.17	0.54	0.24	0.30
Wood	3.60	2.91	-0.08	0.77	0.27	0.50
Furniture and Fixture	0.17	-0.13	0.34	-0.05	-0.45	0.40
Paper and Allied Products	2.47	2.15	0.08	0.24	0.10	0.15
Printing, Publishing &Allied	0.68	0.60	-0.11	0.19	-0.21	0.40
Primary Metal	2.21	1.48	0.17	0.56	0.45	0.12
Fabricated Metal Products	0.44	0.57	-0.04	-0.10	-0.15	0.05
Machinery	0.34	1.07	-0.32	-0.40	-0.65	0.25
Transportation Equipment	3.04	2.82	-0.11	0.33	0.15	0.18
Electrical and Electronic	2.83	2.86	-0.49	0.45	0.11	0.34
Non-metallic Mineral	0.07	0.07	0.00	0.00	-0.04	0.04
Refined Petroleum and Coal	-0.98	3.57	-3.64	-0.92	2.96	-3.88
Chemical	2.41	1.40	-0.05	1.06	0.63	0.43
Other Manufacturing	0.39	0.16	-0.01	0.23	-0.01	0.24
Simple Average	1.37	1.34	-0.26	0.29	0.17	0.12

Note: Annual percentage point growth in labour productivity (LP).

Table A8. Productivity Decomposition by Industry, 1988-1997 GR Approach

	LP Growth	Within-plant	Between-plant	Net entry	Entry	Exit
Food	1.27	1.30	-0.16	0.13	-0.12	0.25
Beverage	5.26	3.56	0.46	1.24	-0.39	1.63
Tobacco	2.47	3.27	-0.74	-0.05	-0.24	0.19
Rubber	4.00	2.67	0.08	1.25	0.66	0.59
Plastic	1.13	1.09	-0.02	0.06	-0.18	0.24
Leather and Allied	1.18	0.44	0.11	0.63	-0.01	0.65
Primary Textile	2.98	2.76	0.11	0.10	-0.05	0.16
Textile Products	1.51	0.63	0.32	0.55	0.00	0.55
Clothing	2.42	0.88	0.38	1.15	0.41	0.74
Wood	1.44	1.41	-0.31	0.33	-0.18	0.52
Furniture and Fixture	2.65	1.69	0.15	0.80	-0.01	0.82
Paper and Allied Products	2.70	2.57	-0.16	0.28	0.16	0.12
Printing, Publishing &Allied	-1.26	-0.97	-0.07	-0.22	-0.25	0.03
Primary Metal	4.04	3.36	0.30	0.37	0.14	0.23
Fabricated Metal Products	0.69	0.76	-0.32	0.25	-0.05	0.30
Machinery	2.79	2.54	0.00	0.26	-0.21	0.47
Transportation Equipment	3.86	3.65	-0.49	0.70	0.23	0.46
Electrical and Electronic	9.37	6.47	0.80	2.09	0.08	2.01
Non-metallic Mineral	1.88	1.01	0.32	0.55	0.07	0.47
Refined Petroleum and Coal	3.65	3.64	-0.39	0.41	-0.01	0.42
Chemical	2.74	2.59	-0.46	0.62	0.06	0.56
Other Manufacturing	1.50	2.29	-0.96	0.17	-0.16	0.33
Simple Average	2.65	2.16	-0.05	0.53	0.00	0.53

Note: Annual percentage point growth in labour productivity (LP).

References

Aw, B.Y., X. Chen and M.J. Roberts. 1997. "Firm-level evidence on productivity differentials, turnover, and exports in Tawainese manufacturing." *NBER Working Paper*, No. 6235.

Baily, M.E., C. Hulten and D. Campbell. 1992. "Productivity dynamics in manufacturing plants." *Brookings Papers on Economic Activity: Microeconomics*, 187-249.

Baldwin, J.R. 1995. *The Dynamics of Industrial Competition.* New York: Cambridge University Press.

Baldwin, J.R. 1996. "Productivity growth, plant turnover and restructuring in the Canadian manufacturing sector." In D.G. Mayes (ed.) *Sources of Productivity Growth*, Cambridge University Press.

Baldwin, J.R. 1998. "Were Small Firms the Engines of Growth in the 1980s?" *Small Business Economics* 10: 349-64.

Baldwin, J.R., D. Beckstead and A. Girard. 2002. *The Importance of Entry to Canadian Manufacturing with an Appendix on Measurement Issues*. Research Paper. Analytical Studies Branch. Forthcoming.

Baldwin, J.R., L. Bian, R. Dupuy and G. Gellatly. 2000. *Failure Rates for New Canadian Firms: New Perspectives for Entry and Exit*. Catalogue No. 61-526. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, J.R., B. Diverty and D. Sabourin. 1995. *Technology Use and Industrial Transformation: Empirical Perspectives*. In T. Courchene (ed.) *Technology, Information, and Public Policy*. John Deutsch Institute for the Study of Economic Policy. Kingston, Ontario: Queens University. pp. 95 –130.

Baldwin, J.R. and N. Dhaliwal. 2000. "Heterogeneity in Labour Productivity Growth in Manufacturing: Differences Between Domestic and Foreign-Controlled Establishments." In *Productivity Growth in Canada*. Catalogue 15-204, pp. 61-75. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, J.R. and P.K. Gorecki (1991) "Entry, exit and productivity growth." In P.K. Geroski and J. Schwalbach (eds.) *Entry and Market Contestability: An International Comparison.* Oxford: Basil Blackwell, 244-56.

Baldwin, J.R, T. Harchaoui, J. Hosein and J.-P. Maynard. 2001. "Productivity: Concepts and Trends." In *Productivity Growth in Canada*. Catalogue 15-204, pp. 13-24. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, J.R. and P. Hanel. 2002. *Innovation and Knowledge Creation in a Small Open Economy*. Cambridge University Press. Forthcoming.

Baldwin, J.R. and M. Rafiquzzaman. 1995. "Selection versus evolutionary adaptation: Learning and post-entry performance." *International Journal of Industrial Organization* 13: 501-522.

Baldwin, J.R. and D. Sabourin. 2001. *Impact of the Adoption of Advanced Information and Communication Technologies on Firm Performance in the Canadian Manufacturing Sector*. Research Paper No. 174. Analytical Studies Branch. Ottawa: Statistics Canada.

Bartelsman, E.J. and P.J. Dhrymes. 1998. "Productivity dynamics: U.S. manufacturing plants 1972-1986." *Journal of Productivity Analysis*, 9, 5-34.

Bartelsman, E.J. and M. Doms. 2000. "Understanding productivity: lessons from longitudinal microdata." *Journal of Economic Literature*, 38, 569-594.

Cable, J. and J. Schwalbach. 1991. "International Comparisons of Entry and Exit." In *Entry and Market Contestability: An International Comparison*. Edited by P.A. Geroski and J. Schwalbach. Oxford: Basil Blackwell. pp. 257-281.

Davis, S.J., J.C. Haltiwanger and S. Schuh. 1996. *Job Creation and Destruction*. Cambridge, M.A.: The MIT Press.

Disney, R., J. Haskel and Y. Heden. 2000. "Restructuring and productivity growth in UK manufacturing." *CEPR Discussion Paper Series*, No. 2463.

Foster, L., J. Haltiwanger and C.J. Krizan. 1998. "Aggregate productivity growth: lessons from microeconomic evidence." NBER Working Paper No. 6803.

Geroski, P. 1991. *Market Dynamics and Entry*. Basil Blackwell.

Geroski, P. and J. Schwalbach (eds.). 1991. *Entry and Market Contestability: An International Comparison*. Oxford: Basil Blackwell.

Globerman, S. 1999. "Implications of Foreign Ownership Restrictions for the Canadian Economy–A Sectoral Analysis." Industry Canada Occasional Paper Series No. 7, Ottawa: Canada.

Griliches, Z. and H. Regev. 1995. "Firm productivity in Israeli industry: 1979-1988." *Journal of Econometrics*, 65, 175-203.

Haltiwanger, J. 1997. "Measuring and Analyzing Aggregate Fluctuations: The Importance of Building from Micro-Economic Evidence." *Saint Louis Federal Reserve Bank Economic Review*. January/February.

Hazledine, T. 1985. "The Anatomy of Productivity Growth Slowdown and Recovery in Canadian Manufacturing." *International Journal of Industrial Organization* 3:307-26.

Neuman, H. 1978. "Strategic Groups and Structure-Performance Relationship." *Review of Economic Statistics.* 60: 417-427.

OECD. 2001. "Productivity and firm dynamics: evidence from microdata." OECD, Paris.

Robson M., J. Townsend and K. Pavitt. 1988. "Sectoral Patterns of Production and Use of Innovations in the UK: 1945-1983." *Research Policy*, 17, 1-14.

Statistics Canada. 1979. "Concepts and definitions of the Census of Manufactures." Catalogue No. 31-528. Ottawa: Statistics Canada.

ANALYTICAL STUDIES
RESEARCH PAPER SERIES

No. 1 *Behavioural Response in the Context of Socio-Economic Microanalytic Simulation,* ***Lars Osberg (April 1986)***

No. 2 *Unemployment and Training,* ***Garnett Picot (1987)***

No. 3 *Homemaker Pensions and Lifetime Redistribution,* ***Michael Wolfson (August 1987)***

No. 4 *Modeling the Lifetime Employment Patterns of Canadians,* ***Garnett Picot (Winter 1986)***

No. 5 *Job Loss and Labour Market Adjustment in the Canadian Economy,* ***Garnett Picot and Ted Wannell (1987)***

No. 6 *A System of Health Statistics: Toward a New Conceptual Framework for Integrating Health Data,* ***Michael C. Wolfson (March 1990)***

No. 7 *A Prototype Micro-Macro Link for the Canadian Household Sector,* ***Hans J. Adler and Michael C. Wolfson (August 1987)***

No. 8 *Notes on Corporate Concentration and Canada's Income Tax,* ***Michael C. Wolfson (October 1987)***

No. 9 *The Expanding Middle: Some Canadian Evidence on the Deskilling Debate,* ***John Myles (Fall 1987)***

No. 10 *The Rise of the Conglomerate Economy,* ***Jorge Niosi (1987)***

No. 11 *Energy Analysis of Canadian External Trade: 1971 and 1976,* ***K.E. Hamilton (1988)***

No. 12 *Net and Gross Rates of Land Concentration,* ***Ray D. Bollman and Philip Ehrensaft (1988)***

No. 13 *Cause-Deleted Life Tables for Canada (1972 to 1981): An Approach Towards Analyzing Epidemiological Transition,* ***Dhruva Nagnur and Michael Nagrodski (November 1987)***

No. 14 *The Distribution of the Frequency of Occurrence of Nucleotide Subsequences, Based on Their Overlap Capability,* ***Jane F. Gentleman and Ronald C. Mullin (1988)***

No. 15 *Immigration and the Ethnolinguistic Character of Canada and Quebec,* ***Réjean Lachapelle (1988)***

No. 16 *Integration of Canadian Farm and Off-Farm Markets and the Off-Farm Work of Women, Men and Children,* ***Ray D. Bollman and Pamela Smith (1988)***

No. 17 *Wages and Jobs in the 1980s: Changing Youth Wages and the Declining Middle,* ***J. Myles, G. Picot and T. Wannell (July 1988)***

No. 18 *A Profile of Farmers with Computers,* ***Ray D. Bollman (September 1988)***

No. 19 *Mortality Risk Distributions: A Life Table Analysis,* ***Geoff Rowe (July 1988)***

No. 20 *Industrial Classification in the Canadian Census of Manufactures: Automated Verification Using Product Data,* ***John S. Crysdale (January 1989)***

No. 21 *Consumption, Income and Retirement,* ***A.L. Robb and J.B. Burbridge (1989)***

No. 22 *Job Turnover in Canada's Manufacturing Sector,* ***John R. Baldwin and Paul K. Gorecki (Summer 1989)***

No. 23 *Series on The Dynamics of the Competitive Process,* ***John R. Baldwin and Paul K. Gorecki (1990)***

A. *Firm Entry and Exit Within the Canadian Manufacturing Sector.*
B. *Intra-Industry Mobility in the Canadian Manufacturing Sector.*
C. *Measuring Entry and Exit in Canadian Manufacturing: Methodology.*
D. *The Contribution of the Competitive Process to Productivity Growth: The Role of Firm and Plant Turnover.*
E. *Mergers and the Competitive Process.*
F. *n/a*
G. *Concentration Statistics as Predictors of the Intensity of Competition.*
H. *The Relationship Between Mobility and Concentration for the Canadian Manufacturing Sector.*

No. 24 *Mainframe SAS Enhancements in Support of Exploratory Data Analysis,* ***Richard Johnson, Jane F. Gentleman and Monica Tomiak (1989)***

No. 25 *Dimensions of Labour Market Change in Canada: Intersectoral Shifts, Job and Worker Turnover,* ***John R. Baldwin and Paul K. Gorecki (1989)***

No. 26 *The Persistent Gap: Exploring the Earnings Differential Between Recent Male and Female Postsecondary Graduates,* ***Ted Wannell (1989)***

No. 27 *Estimating Agricultural Soil Erosion Losses From Census of Agriculture Crop Coverage Data,* ***Douglas F. Trant (1989)***

No. 28 *Good Jobs/Bad Jobs and the Declining Middle: 1967-1986,* ***Garnett Picot, John Myles, Ted Wannel (1990)***

No. 29 *Longitudinal Career Data for Selected Cohorts of Men and Women in the Public Service, 1978-1987,* ***Garnett Picot and Ted Wannell (1990)***

No. 30 *Earnings and Death-Effects Over a Quarter Century,* ***Michael Wolfson, Geoff Rowe, Jane F. Gentleman and Monica Tomiak (1990)***

No. 31 *Firm Response to Price Uncertainty: Tripartite Stabilization and the Western Canadian Cattle Industry,* ***Theodore M. Horbulyk (1990)***

No. 32 *Smoothing Procedures for Simulated Longitudinal Microdata,* ***Jane F. Gentleman,Dale Robertson and Monica Tomiak (1990)***

No. 33 *Patterns of Canadian Foreign Direct Investment Abroad,* ***Paul K. Gorecki (1990)***

No. 34 *POHEM - A New Approach to the Estimation of Health Status Adjusted Life Expectancy,* ***Michael C. Wolfson (1991)***

No. 35 *Canadian Jobs and Firm Size: Do Smaller Firms Pay Less?,* ***René Morissette (1991)***

No. 36 *Distinguishing Characteristics of Foreign High Technology Acquisitions in Canada's Manufacturing Sector,* ***John R. Baldwin and Paul K. Gorecki (1991)***

No. 37 *Industry Efficiency and Plant Turnover in the Canadian Manufacturing Sector,* ***John R. Baldwin (1991)***

No. 38 *When the Baby Boom Grows Old: Impacts on Canada's Public Sector,* **Brian B. Murphy and Michael C. Wolfson (1991)**

No. 39 *Trends in the Distribution of Employment by Employer Size: Recent Canadian Evidence,* **Ted Wannell (1991)**

No. 40 *Small Communities in Atlantic Canada: Their Industrial Structure and Labour Market Conditions in the Early 1980s,* **Garnett Picot and John Heath (1991)**

No. 41 *The Distribution of Federal/Provincial Taxes and Transfers in Rural Canada,* **Brian B. Murphy (1991)**

No. 42 *Foreign Multinational Enterprises and Merger Activity in Canada,* **John Baldwin and Richard Caves (1992)**

No. 43 *Repeat Users of the Unemployment Insurance Program,* **Miles Corak (1992)**

No. 44 *POHEM -- A Framework for Understanding and Modeling the Health of Human Populations,* **Michael C. Wolfson (1992)**

No. 45 *A Review of Models of Population Health Expectancy: A Micro-Simulation Perspective,* **Michael C. Wolfson and Kenneth G. Manton (1992)**

No. 46 *Career Earnings and Death: A Longitudinal Analysis of Older Canadian Men,* **Michael C. Wolfson, Geoff Rowe, Jane Gentleman and Monica Tomiak (1992)**

No. 47 *Longitudinal Patterns in the Duration of Unemployment Insurance Claims in Canada,* **Miles Corak (1992)**

No. 48 *The Dynamics of Firm Turnover and the Competitive Process,* **John Baldwin (1992)**

No. 49 *Development of Longitudinal Panel Data from Business Registers: Canadian Experience,* **John Baldwin, Richard Dupuy and William Penner (1992)**

No. 50 *The Calculation of Health-Adjusted Life Expectancy for a Canadian Province Using a Multi-Attribute Utility Function: A First Attempt,* **J.-M. Berthelot, R. Roberge and M.C. Wolfson (1992)**

No. 51 *Testing the Robustness of Entry Barriers,* **J.R. Baldwin and M. Rafiquzzaman (1993)**

No. 52 *Canada's Multinationals: Their Characteristics and Determinants,* **Paul K. Gorecki (1992)**

No. 53 *The Persistence of Unemployment: How Important were Regional Extended Unemployment Insurance Benefits?,* **Miles Corak, Stephen Jones (1993)**

No. 54 *Cyclical Variation in the Duration of Unemployment Spells,* **Miles Corak (1992)**

No. 55 *Permanent Layoffs and Displaced Workers: Cyclical Sensitivity, Concentration, and Experience Following the Layoff,* **Garnett Picot and Wendy Pyper (1993)**

No. 56 *The Duration of Unemployment During Boom and Bust,* **Miles Corak (1993)**

No. 57 *Getting a New Job in 1989-90 in Canada,* **René Morissette (1993)**

No. 58 *Linking Survey and Administrative Data to Study Determinants of Health,* **P. David, J.-M. Berthelot and C. Mustard (1993)**

No. 59 *Extending Historical Comparability in Industrial Classification,* **John S. Crysdale (1993)**

No. 60 *What is Happening to Earnings Inequality in Canada?,* **R. Morissette, J. Myles and G. Picot (June 1994)**

No. 61 *Structural Change in the Canadian Manufacturing Sector, (1970-1990),* ***J. Baldwin and M. Rafiquzzaman (July 1994)***

No. 62 *Unemployment Insurance, Work Disincentives, and the Canadian Labour Market: An Overview,* ***Miles Corak (January 1994)***

No. 63 *Recent Youth Labour Market Experiences in Canada,* ***Gordon Betcherman and René Morissette (July 1994)***

No. 64 *A Comparison of Job Creation and Job Destruction in Canada and the United States,* ***John Baldwin, Timothy Dunne and John Haltiwanger (July 1994)***

No. 65 *What is Happening to Weekly Hours Worked in Canada?,* ***René Morissette and Deborah Sunter (June 1994)***

No. 66 *Divergent Inequalities -- Theory, Empirical Results and Prescriptions,* ***Michael C. Wolfson (May 1995)***

No. 67 *XEcon: An Experimental / Evolutionary Model of Economic Growth,* ***Michael C. Wolfson (June 1995)***

No. 68 *The Gender Earnings Gap Among Recent Postsecondary Graduates, 1984-92,* ***Ted Wannell and Nathalie Caron (November 1994)***

No. 69 *A Look at Employment-Equity Groups Among Recent Postsecondary Graduates: Visible Minorities, Aboriginal Peoples and the Activity Limited,* ***Ted Wannell and Nathalie Caron (November 1994)***

No. 70 *Employment Generation by Small Producers in the Canadian Manufacturing Sector,* ***John R. Baldwin and Garnett Picot (November 1994)***

No. 71 *Have Small Firms Created a Disproportionate Share of New Jobs in Canada? A Reassessment of the Facts,* ***Garnett Picot, John Baldwin and Richard Dupuy (November 1994)***

No. 72 *Selection Versus Evolutionary Adaptation: Learning and Post-Entry Performance,* ***J. Baldwin and M. Rafiquzzaman (May 1995)***

No. 73 *Business Strategies in Innovative and Non-Innovative Firms in Canada,* ***J. Baldwin and J. Johnson (February 1995)***

No. 74 *Human Capital Development and Innovation: The Case of Training in Small and Medium Sized-Firms,* ***J. Baldwin and J. Johnson (March 1995)***

No. 75 *Technology Use and Industrial Transformation: Emprirical Perspectives,* ***John Baldwin, Brent Diverty and David Sabourin (August 1995)***

No. 76 *Innovation: The Key to Success in Small Firms,* ***John R. Baldwin (February 1995)***

No. 77 *The Missing Link: Data on the Demand side of Labour Markets,* ***Lars Osberg (April 1995)***

No. 78 *Restructuring in the Canadian Manufacturing Sector from 1970 to 1990: Industry and Regional Dimensions of Job Turnover.* ***J. Baldwin and M. Rafiquzzaman (July 1995)***

No. 79 *Human Capital and the Use of Time,* ***Frank Jones (June 1995)***

No. 80 *Why Has Inequality in Weekly Earnings Increased in Canada?,* ***René Morissette (July 1995)***

No. 81 *Socio-Economic Statistics and Public Policy: A New Role For Microsimulation Modeling,* ***Michael C. Wolfson (July 1995)***

No. 82 *Social Transfers, Changing Family Structure, and Low Income Among Children,* **Garnett Picot and John Myles (September 1995)**

No. 83 *Alternative Measures of the Average Duration of Unemployment,* **Miles Corak and Andrew Heisz (October 1995)**

No. 84 *The Duration of Unemployment: A User Guide,* **Miles Corak and Andrew Heisz (December 1995)**

No. 85 *Advanced Technology Use in Manufacturing Establishments,* **John R. Baldwin and Brent Diverty (November 1995)**

No. 86 *Technology Use, Training and Plant-Specific Knowledge in Manufacturing Establishments,* **John R. Baldwin, Tara Gray and Joanne Johnson (December 1995)**

No. 87 *Productivity Growth, Plant Turnover and Restructuring in the Canadian Manufacturing Sector,* **John R. Baldwin (November 1995)**

No. 88 *Were Small Producers the Engines of Growth in the Canadian Manufacturing Sector in the 1980s?,* **John R. Baldwin (October 1996)**

No. 89 *The Intergenerational Income Mobility of Canadian Men,* **Miles Corak and Andrew Heisz (January 1996)**

No. 90 *The Evolution of Payroll Taxes in Canada: 1961 - 1993,* **Zhengxi Lin, Garnett Picot and Charles Beach (February 1996)**

No. 91 *Project on Matching Census 1986 Database and Manitoba Health Care Files: Private Households Component,* **Christian Houle, Jean-Marie Berthelot, Pierre David, Cam Mustard, L. Roos and M.C. Wolfson (March 1996)**

No. 92 *Technology-induced Wage Premia in Canadian Manufacturing Plants during the 1980s,* **John Baldwin, Tara Gray and Joanne Johnson (December 1996)**

No. 93 *Job Creation by Company Size Class: Concentration and Persistence of Job Gains and Losses in Canadian Companies,* **Garnett Picot and Richard Dupuy (April 1996)**

No. 94 *Longitudinal Aspects of Earnings Inequality in Canada,* **René Morissette and Charles Bérubé (July 1996)**

No. 95 *Changes in Job Tenure and Job Stability in Canada,* **Andrew Heisz (November 1996)**

No. 96 *Are Canadians More Likely to Lose Their Jobs in the 1990s?,* **Garnett Picot and Zhengxi Lin (August 6, 1997)**

No. 97 *Unemployment in the Stock and Flow,* **Michael Baker, Miles Corak and Andrew Heisz (September 1996)**

No. 98 *The Effect of Technology and Trade on Wage Differentials Between Nonproduction and Production Workers in Canadian Manufacturing,* **John R. Baldwin and Mohammed Rafiquzzaman (May 1998)**

No. 99 *Use of POHEM to Estimate Direct Medical Costs of Current Practice and New Treatments Associated with Lung Cancer in Canada,* **C. Houle, B.P. Will, J.-M. Berthelot, Dr. W.K. Evans (May 1997)**

No.100 *An Experimental Canadian Survey That Links Workplace Practices and Employee Outcomes: Why it is Needed and How it Works,* **Garnett Picot, Ted Wannell (May 1997)**

No.101 *Innovative Activity in Canadian Food Processing Establishments: The Importance of Engineering Practices,* **John Baldwin and David Sabourin (November 1999)**

No. 102 Differences in Strategies and Performances of Different Types of Innovators, ***John R. Baldwin and Joanne Johnson (December 1997)***

No.103 Permanent Layoffs in Canada: Overview and Longitudinal Analysis, ***Garnett Picot, Zhengxi Lin and Wendy Pyper (September, 1997)***

No.104 Working More? Working Less? What do Canadian Workers Prefer?, ***Marie Drolet and René Morissette (May 20, 1997)***

No.105 Growth of Advanced Technology Use in Canadian Manufacturing During the 1990's, ***by John Baldwin, Ed Rama and David Sabourin (December 14, 1999)***

No.106 Job Turnover and Labour Market Adjustment in Ontario from 1978 to 1993, ***by Zhengxi Lin and Wendy Pyper (1997)***

No.107 The Importance of Research and Development for Innovation in Small and Large Canadian Manufacturing Firms, ***John R. Baldwin (September 24, 1997)***

No.108 International Competition and Industrial Performance: Allocative Efficiency, Productive Efficiency, and Turbulence, ***John R. Baldwin and Richard E. Caves (October 1997)***

No.109 The Dimensions of Wage Inequality among Aboriginal Peoples, ***Rachel Bernier (December 1997)***

No.110 Trickling Down or Fizzling Out? Economic Performance, Transfers, Inequality and Low Income, ***Myles Zyblock and Zhengxi Lin (December 10, 1997)***

No.111 Corporate Financial Leverage: A Canada - U.S. Comparison, 1961-1996, ***Myles Zyblock (December 1997)***

No.112 An explanation of the Increasing Age Premium, ***Constantine Kapsalis (July 1998)***

No.113 The Intergenerational Earnings and Income Mobility of Canadian Men: Evidence from Longitudinal Income Tax Data, ***Miles Corak and Andrew Heisz (October, 1998)***

No.114 Foreign-Born vs Native-Born Canadians: A Comparison of Their Inter-Provincial Labour Mobility, ***Zhengxi Lin (September 1998)***

No.115 Living Arrangements and Residential Overcrowding: the situation of older immigrants in Canada, 1991, ***K.G. Basavarajappa (September 1998)***

No.116 What is Happening to Earnings Inequality and Youth Wages in the 1990s?, ***Garnett Picot (July 1998)***

No 117 The Determinants of the Adoption Lag for Advanced Manufacturing Technologies, ***John R. Baldwin and Mohammed Rafiquzzaman (August 1998)***

No. 118 Labour Productivity Differences Between Domestic and Foreign-Controlled Establishments in the Canadian Manufacturing Sector, ***John R. Baldwin and Naginder Dhaliwal (March 1, 2000)***

No.119 Technology Adoption: A Comparison Between Canada and the United States, ***John R. Baldwin and David Sabourin (August 1998)***

No.120 Are There High-Tech Industries or Only High-Tech Firms? Evidence From New Technology-Based firms, ***John R. Baldwin and Guy Gellatly (December 1998)***

No.121 A Portrait of Entrants and Exits, ***John R. Baldwin (June 1999)***

No.122 *Determinants of Innovative Activity in Canadian Manufacturing Firms: The Role of Intellectual Property Right,* ***John R. Baldwin, Petr Hanel and David Sabourin (March 7, 2000)***

No.123 *Innovation and Training in New Firms* ***John R. Baldwin (November 2000)***

No.124 *New Views on Inequality Trends in Canada and the United States,* ***Michael C. Wolfson and Brian B. Murphy (August 1998 and October 1999 (paper)***

No.125 *Employment Insurance in Canada: Recent Trends and Policy Changes,* ***Zhengxi Lin (September 1998)***

No.126 *Computers, Fax Machines and Wages in Canada: What Really Matters?,* ***René Morissette and Marie Drolet (October 1998)***

No.127 *Understanding the Innovation Process: Innovation in Dynamic Service Industries,* ***Guy Gellatly and Valerie Peters (December 1999)***

No.128 *Recent Canadian Evidence on Job Quality by Firm Size,* ***Marie Drolet and René Morissette (November 1998)***

No.129 *Distribution, Inequality and Concentration of Income Among Older Immigrants in Canada, 1990 ,* ***K.G. Basavarajappa (April 1999)***

No.130 *Earnings Dynamics and Inequality among Canadian Men, 1976-1992: Evidence from Longitudinal Income Tax Records,* ***Michael Baker and Gary Solon (February 1999)***

No 131 *The Returns to Education, and the Increasing Wage Gap Between Younger and Older Workers,* ***C. Kapsalis, R. Morissette and G. Picot (March 1999)***

No.132 *Why Do Children Move Into and Out of Low Income: Changing Labour Market Conditions or Marriage and Divorce?,* ***G. Picot, M. Zyblock and W. Pyper (March 1999)***

No.133 *Rising Self-Employment in the Midst of High Unemployment: An Empirical Analysis of Recent Developments in Canada,* ***Zhengxi Lin, Janice Yates and Garnett Picot (March 1999)***

No.134 *The Entry and Exit Dynamics of Self-Employment in Canada,* ***Zhengxi Lin, Garnett Picot and Janice Yates (March 1999)***

No.135 *Death and Divorce: The Long-term Consequences of Parental Loss on Adolescents,* ***Miles Corak (June 9, 1999)***

No.136 *N/A*

No.137 *Innovation, Training and Success,* ***John Baldwin (October 1999)***

No.138 *The Evolution of Pension Coverage of Young and Older Workers in Canada,* ***René Morissette and Marie Drolet (December 1999)***

No.139 *Import Competition and Market Power: Canadian Evidence,* ***Aileen J. Thompson (April 2000)***

No.140 *Gender Composition and Wages: Why is Canada Different from the United States,* ***Michael Baker and Nicole Fortin (August 2000)***

No.141 *The Transition to Work for Canaddian University Graduates: Time to First Job, 1982-1990,* ***Julian Betts, Christopher Ferrall and Ross Finnie (December 2000)***

No.142 Who Moves? A Panel Logit Model Analysis of Interprovincial Migration in Canada, ***Ross Finnie (August 2000)***

No.143 Differences in Innovator and Non-Innovator Profiles: Small Establishments in Business Services, ***Guy Gellatly (December 1999)***

No.144 Social Transfers, Earnings and Low-Income Intensity Among Canadian Children, 1981-1996: Highlighting Recent Development in Low-Income Measurement, ***John Myles and Garnett Picot (March 2000)***

No.145 How Much of Canada's Unemployment is Structural?, ***Lars Osberg and Zhengxi Lin (October 2000)***

No.146 To What Extent Are Canadians Exposed to Low-Income?, ***René Morissette and Marie Drolet (April, 2000)***

No.147 The Maturation of Canada's Retirement Income System: Income Levels, Income Inequality and Low-Income among the Elderly, ***John Myles (March 6, 2000)***

No.148 The Performance of the 1990s Canadian Labour Market, ***Garnett Picot and Andrew Heisz (April, 2000)***

No.149 Payroll Taxes in Canada Revisited: Structure, Statutory Parameters, and Recent Trends ***Zhengxi Lin (August, 2001)***

No.150 Patterns of Corporate Diversification in Canada: An Empirical Analysis, ***John R. Baldwin, Desmond Beckstead,Guy Gellatly and Alice Peters (June, 2000)***

No.151 Multinationals and the Canadian Innovation Process, ***John R. Baldwin and Petr Hanel (June, 2000)***

No.152 Rural Youth: Stayers, Leavers and Return Migrants, ***Richard Dupuy, Francine Mayer and René Morissette (September 5, 2000)***

No.153 Female Employment Rates and Labour Market Attachment in Rural Canada, ***Euan Phimster, Esperanza Vera Toscano, Alfons Weersink (December 2000)***

No.154 Training as a Human Resource Strategy: The Response to Staff Shortages and Technological Change, ***John R. Baldwin and Valerie Peters (April 2001)***

No.155 Job Tenure, Worker Mobility and the Youth Labour Market during the 1990s, ***G. Picot, A. Heisz and A. Nakamura (March 2001)***

No.156 The Impact of International Trade on the Wages of Canadians, ***Omar Zakhilwal (December 2000)***

No.157 The Persistent Gap: New Evidence on the Canadian Gender Wage Gap, ***Marie Drolet (December 2000)***

No.158 In Search of Intergenerational Credit Constraints Among Canadian Men: Quantile Versus Mean Regression Tests for Binding Crefdit Constraints, ***Nathan D. Grawe (December 2000)***

No.159 Intergenerational Influences on the Receipt of Unemployment Insurance in Canada and Sweden, ***Miles Corak, Bjorn Gustaffson and Torun Osterberg (December 2000)***

No.160 Neighbourhood Inequality in Canadian Cities, ***John Myles, Garnett Picot and Wendy Pyper (December 13, 2000)***

No.161 Forthcoming

No.162 The Evolution of Job Stability in Canada: Trends and Comparisons to U.S. Results, ***Andrew Heisz (October 16, 2002)***

No.163 *The Effects of Inter-Provincial Mobility on Individuals' Earnings: Panel Model Estimates for Canada,* ***Ross Finnie (October, 2001)***

No.164 *Early Labour Market Outcomes of Recent Canadian University Graduates by Discipline: A Longitudinal, Cross-Cohort Analysis,* ***Ross Finnie (March 2002)***

No.165 *Innovation and Connectivity: The Nature of Market Linkages and Innovation Networks in Canadian Manufacturing Industries,* ***John Baldwin and Alice Peters (May 2001)***

No.166 *An Assessment of EI and SA Reporting in SLID,* ***Constantine Kapsalis (August, 2001)***

No.167 ***Forthcoming***

No.168 *Enhancing Food Safety and Productivity: Technology Use in the Canadian Food Processing Industry,* ***John R. Baldwin and David Sabourin (May 2002)***

No.169 *Dynamics of the Canadian Manufacturing Sector in Metropolitan and Rural Regions,* ***John R. Baldwin and Mark Brown with Tara Vinodrai (November 2001)***

No170 *Income Prospects of British Columbia University Graduates,* ***Andrew Heisz (May 2001)***

No.171 *Are the Kids All Right? Intergenerational Mobility and Child Well-being in Canada,* ***Miles Corak (October 2001)***

No.172 *Low-Income Intensity During the 1990s: The Role of Economic Growth, Employment Earnings and Social Transfers,* ***G. Picot, R. Morissette, J. Myles (January 24, 2003)***

No.173 *Impediments to Advanced Technology Adoption for Canadian Manufacturers,* ***John Baldwin and Zhengxi Lin (August, 2001)***

No.174 *Impact of the Adoption of Advanced Information and Communication Technologies on Firm Performance in the Canadian Manufacturing Sector,* ***John R. Baldwin and David Sabourin (October, 2001)***

No.175 *Skill Shortages and Advanced Technology Adoption,* ***David Sabourin (September, 2001)***

No.176 *Which Firms Have High Job Vacancy Rates in Canada?,* ***René Morissette, Xuelin Zhang (October 25, 2001)***

No.177 *A Tale of Three Cities: The Dynamics of Manufacturing in Toronto, Montreal and Vancouver, 1976-1997,* ***Tara Vinodrai (November 2001)***

No.178 *School Performance of the Children of Immigrants in Canada, 1994-98,* ***Christopher Worswick (November 14, 2001)***

No.179 *Changes in the Diversification of Canadian Manufacturing Firms (1973-1997): A Move to Specialization,* ***John R. Baldwin, Desmond Beckstead and Richard Caves (February 2002)***

No.180 *Differences in Interprovincial Productivity Levels,* ***John R. Baldwin, Jean-Pierre Maynard, David Sabourin and Danielle Zietsma (December 2001)***

No.181 *Does Parent or Child Know Best? An Assessment of Parent/Child Agreement in the Canadian National Longitudinal Survey of Children and Youth,* ***Lori Curtis, Martin Dooley and Shelley Phipps*** *(October 23, 2002)*

No.182 *Effects of Selection Criteria and Economic Opportunities on the Characteristics of Immigrants,* ***by Abdurrahman Aydemir*** *(October 23, 2002)*

No.183 *Setting up Shop: Self-Employment Amongst Canadian College and University Graduates,* **Ross Finnie, Christine Laporte, Maud-Catherine Rivard (March 2002)**

No.184 *Winners and Losers in the Labour Market of the 1990s,* **Andrew Heisz, Andrew Jackson, Garnett Picot (February 2002)**

No.185 *Do Neighbourhoods Influence Long Term Labour Market Success? A Comparison of Adults who Grew Up in Different Public Housing Projects,* **Philip Oreopoulos (June 2002)**

No.186 *Wives, Mothers and Wages: Does Timing Matter?* **Marie Drolet (May 1, 2002)**

No.187 *The Evolution of Wealth Inequality in Canada, 1984-1999,* **René Morissette, Xuelin Zhang and Marie Drolet (February 2002)**

No.188 *Management Experience and Diversity in an Aging Organization,* **Ted Wannell and Martin Gravel (August 2002)**

No.189 *The Importance of Entry to Canadian Manufacturing with an Appendix on Measurement Issues,* **John Baldwin, Desmond Beckstead and Andrée Girard (May 2002)**

No.190 *Financing Innovation in New Small Firms : Evidence From Canada,* **John R,. Baldwin, Guy Gellatly and Valérie Gaudreault (May 2002)**

No.191 *Too Far to Go On? Distance to School and University Participation,* **Marc Frenette (June 24, 2002)**

No.192 *Life After Welfare: The Economic Well-Being of Welfare Leavers in Canada during the 1990s,* **Marc Frenette, Garnet Picot (March 26, 2003)**

No.193 *Plant Turnover and Productivity Growth in Canadian Manufacuturing,* **John Baldwin, Wulong Gu (April 2, 2003)**

No.194 *Wage Progression of Less Skilled Workers in Canada: Evidence from the SLID (1993-1998),* **Xuelin Zhang (December 6, 2002)**

No.195 *Do the Falling Earnings of Immigrants Apply to Self-Employed Immigrants?,* **Marc Frenette (December 2002)**

No.196 *Minorities, Cognitive Skills and the Incomes of Canadians,* **Ross Finnie and Ronald Meng (January 24, 2003)**

No.197 *Forthcoming*

No.198 *Forthcoming*

No.199 *Alternative Work Practices and Quit Rates: Methodological Issues and Empirical Evidence For Canada,* **René Morissette and Julio Miguel Rosa (March 17, 2003)**

No.200 *Forthcoming*